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WEST VIRGINIA GEOLOGICAL SURVEY

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PLATE I.—Winifrede Coal Seam in Splint mine of Carbon Coal Company, Cabin Creek District.

WEST VIRGINIA

GEOLOGICAL SURVEY

Kanawha County

By

CHARLES E. KREBS, Assistant Geologist

and

D. D. TEETS, JR., Field Assistant

Part IV— Paleontology, by W. ARMSTRONG PRICE
Paleontologist.

Introduction

By

I. C. WHITE, State Geologist.

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J. LEWIS WILLIAMS.....*Stenographer*

LETTER OF TRANSMITTAL.

To His Excellency, Hon. Henry D. Hatfield, Governor of West Virginia, and President of the West Virginia Geological Survey Commission:

Sir: I have the honor to transmit herewith the Detailed Report and Soil, Topographic and Geologic maps covering the county of Kanawha, prepared by Mr. C. E. Krebs, Assistant Geologist, and D. D. Teets, his Field Assistant. Kanawha has long stood near the head of the list of West Virginia counties, not only in the production of commercial coal, but also in the quantity, purity, and variety of the product, there having been mined ordinary bituminous coal, gas coal, coking coal, "splint" coal, block coal, cannel coal, and many intermediate grades within her borders. Kanawha is also rich in clays, shales, and building stone, and added to all these riches she holds a very large heritage in petroleum, as well as one of the greatest gas fields of the State centered about Charleston, her county seat, and the Capital of the State.

With fertile soils whose productivity can be greatly increased by careful attention to the very interesting and thorough work of the experts of the U. S. Bureau of Soils, Messrs. Latimer and Beck, as published in the latter portion of this Report, together with all the mineral riches herein described, there is no reason why Kanawha county may not continue to hold indefinitely the primacy in wealth and population which she now possesses over all the sister counties of our Commonwealth, and that her Capital city may not continue its recent wonderful growth indefinitely.

Very respectfully,

I. C. WHITE, STATE GEOLOGIST.

Morgantown, W. Va., April 1st, 1914.

CONTENTS.

	Page.
Members of Geological Survey Commission and State Board of Control	III
Members of Scientific Staff	V
Letter of Transmittal	VI
Table of Contents	VII
Author's Preface	XIII
Introduction by I. C. White	XVII
Errata	XXVIII

PART I. HISTORY AND PHYSIOGRAPHY.

Chapter I.—Historical and Industrial Development	1-29
Location	1
General Description	1-23
Miscellaneous	1-4
Towns and Industries	4-14
Indian Mounds	14-23
History of Transportation	23-29
Water Ways	23-24
Kanawha River	23
Elk River	24
Coal River	24
Steam Railroads	24-29
Chesapeake & Ohio Railroad and Branches	24-26
Kanawha & Michigan Railroad	26
Kanawha & West Virginia Railroad	26
Coal & Coke Railway	26-27
Kanawha & Coal River Railroad	27
Kanawha Central Railroad	27
West Virginia Southern Railway	27
Winifrede Railroad	27
Campbells Creek Railroad	27
Kelly Creek Railroad	27
Kelly Creek & Northwestern Railroad	27
Electric Railroads	28
Charleston Interurban Company	28
Charleston-Dunbar Traction Company	28
Highways	28-29
James River & Kanawha Turnpike	28-29
Giles, Fayette & Kanawha Turnpike	29
Charleston & Point Pleasant Turnpike	29
Charleston & Ravenswood Turnpike	29
Guyandotte & Charleston Turnpike	29
Chapter II.—Physiography	30-54
Physiographic Changes	30
Description of Drainage Basins	30-52
Kanawha River	33-41
Coal River	41-42

	Page.
Davis Creek	42
Lens Creek	42-43
Fields Creek	43
Slaughter Creek	43
Cabin Creek	43
Paint Creek	44
Pocatalico River	44-45
Kanawha Twomile Creek	46
Elk River	46-49
Campbell Creek	49
Witchers Creek	49
Kelly Creek	49-50
Hughes Creek	50
New River	50
Gauley River	51
River Terraces	52-54

PART II. GEOLOGY.

Chapter III.—Structure	55-65
Introduction	55-56
Method of Representing Structure	56-58
Detailed Geologic Structure	58-65
Anticlines	58-62
Synclines	62-65
Chapter IV.—Stratigraphy—General Sections	66-107
Introduction	66
Sections	66-105
Summary	106
Thickness of Stratified Rocks	107
Chapter V.—Stratigraphy—The Dunkard Series	108-115
General Account	108
Sections	109-111
Description of Formations	111-115
Age of Series	115
Chapter VI.—Stratigraphy—The Monongahela Series	116-126
General Account	116
Sections	116-120
Description of Formations	121-126
Chapter VII.—Stratigraphy—The Conemaugh Series	127-182
General Account and Section	127-128
Sections	128-159
Description of Formations	159-182
Chapter VIII.—Stratigraphy—The Allegheny Series	183-209
General Account	183
Sections	183-199
Description of Formations	199-209
Chapter IX.—Stratigraphy—The Pottsville Series	210-295
General Account	210-212
General Section (The revised section prepared by Ray V. Hennen is published in the Introduction by I. C. White)	212-214
Sections	214-253
Description of Formations	254-295

PART III. MINERAL RESOURCES.

Chapter X.—Petroleum and Natural Gas 296-399
Early History 296-298
Oil and Gas Horizons 299-300
Description of Sands 301-303
Oil and Gas Development, Historical 303
Well Records 303-399
Summarized Table of Well Records 304-305
Poca District 305-309
Union District 310-318
Jefferson District 318-324
Washington District 324-327
Elk District 327-361
Big Sandy District 361-379
Loudon District 379-385
Charleston District 385-387
Cabin Creek District 387-394
Malden District 394-399

Chapter XI.—Coal 400-578
Statistics of Coal Production 400-409
Minable Coals of the Monongahela Series 409-418
Pittsburgh Coal 409-418
Minable Coals of the Conemaugh Series 418
Minable Coals of the Allegheny Series 419
No. 5 Block Coal 419-454
Minable Coals of the Kanawha Series 454-566
Stockton-Lewiston Coal 454-474
Coalburg Coal 474-492
Winifrede Coal 492-513
Chilton Coal 513
Thacker Coal 513-516
Cedar Grove Coal 516-527
Peerless Coal 527-534
No. 2 Gas Coal 534-556
Powellton Coal 556-559
Eagle Coal 560-566
Little Eagle Coal 566
Summary of Available Coal by Districts 566-569
Core Drill Holes and Well Records 569-578

Chapter XII.—Clays, Road Materials, Building Stone, Salt Industry, Iron Ore, Forests and Carbon Black 579-606
Clays and Clay Industry 579-588
Road Materials 588-589
Building Stone 589-595
Salt Industry 595-601
History 595-596
Salt Works 596-599
Geology of the Salt Horizon 599-601
Iron Ore 601
Forests 601-605
Carbon Black Industry 605-606

Chapter XIII.—Soil Survey 607-638
Description of the Area 607-609
Climate 609-610
Agriculture 611-614
Soils 614-636
Summary 636-638

PART IV. PALEONTOLOGY.

Chapter XIV.—Paleontology 639-655
Scope of Investigation 639
Faunal Horizons 640-642
Correlation 643-644
Description of Species 645-654
Plates I and II 654-655

Appendix 656-666
Railway Levels 656-660
Chesapeake & Ohio Ry., Main Line and Branches 656-658
Kanawha & Michigan Railway 659
Kanawha & W. Va Railway 660
Coal & Coke Railway 660
Levels above tide determined by U. S. Geological Survey ... 661-666

ILLUSTRATIONS.

Maps in Atlas (Under Separate Cover).

Topographic Map of Kanawha County.

Map Showing Economic Geology and Structure Contours of Pittsburgh Coal in the Western part of the County, and the Kanawha Black Flint in the Eastern part of the County.

Soil Map of Kanawha County.

Plates No.	Facing Page.
I.—Winifrede Coal Seam in Splint Mine of Carbon Coal Company, Cabin Creek District	Frontispiece
II.—Charleston in 1854, Taken from an Old Painting	4
III.—Birdseye View of Charleston, 1913	6
IV.—State Capitol Building Charleston, W. Va.	8
V.—Lock No. 6 Showing Conemaugh Series	34
VI.—Edgewood Country Club House, in Conemaugh Series near Charleston	96
VII(a).—Scene on Poca River West of Sissonville, Showing Monongahela Series	118
VII(b).—Scene on Poca River west of Sissonville, Showing Monongahela Series	118
VIII.—Scene on Elk River at Charleston, Showing the Base of the Conemaugh, Allegheny and top of Kanawha Series.	140
IX.—Blue Creek Oil Field at Blue Creek	150
X.—Blue Creek Oil Field, ½ Mile South of Blue Creek, Showing the Chloe Copenhaver Wells	152
XI.—Scene in Blue Creek Oil Field, Showing Conemaugh Series	154
XII.—J. E. Brown Well No. 1 (On Fire), Blue Creek Field	156
XIII(a).—Jordan Creek Oil Field, Big Sandy District	158
XIII(b).—Squaw Sand Taken from Chloe Copenhaver Well No. 2, Blue Creek Oil Field, One-half Size	158
XIV.—Kanawha & New River Brick Company, Clay Mine at Kanawha Two Mile. Showing Elk Fire Clay	178
XV.—Saltsburg-Buffalo Sandstone Quarry at Spring Hill	180
XVI.—Saltsburg-Buffalo Sandstone Quarry at Spring Hill	182
XVII.—Homewood Sandstone at Mouth of Kingshoal Creek, Big Sandy District	254
XVIII(a).—Scene on Paint Creek, Showing the Kanawha Series in Southern Part of Kanawha County	256
XVIII(b).—Kanawha Black Flint in C. & O. Railroad Cut Just East of the C. & O. Depot, Charleston	256
XIX(a).—Chimney Rock, Coalburg Sandstone on Kanawha River East of Coalburg	268
XIX(b).—Scene East of Charleston, Showing the Kanawha Series Capped with the Allegheny	268
XX.—Coalburg Sandstone at Acme, Cabin Creek District	270
XXI(a).—Winifrede Sandstone on Kanawha River East of Pratt	272

XXI(b).—Winifrede Sandstone on Paint Creek near Paint Creek Junction..... 272
XXII.—Winifrede Sandstone, Overlooking the Kanawha River East of Coalburg..... 276
XXIII.—Mucklow Looking North, Showing the Kanawha Series on Paint Creek, Cabin Creek District..... 282
XXIV.—Scene on Kelly Creek at Ward, Showing Kanawha Series 288
XXV.—Mine Car Loaded with Coalburg Coal from the Mine of the Kelly Creek Colliery Company..... 480
XXVI.—Winifrede Coal in Mine of Carbon Coal Company, South Carbon Mine..... 496
XXVII.—Scene on Cabin Creek at South Carbon Mine, Showing No. 2 Gas Coal Mine..... 544
XXVIII.—Scene at Crescent, ½ Mile South of the Kanawha-Fayette County Line, Showing the Mines of the No. 5 Block Coal, No. 2 Gas and Eagle Coals..... 550
XXIX.—Eagle Coal, Milburn Mine, Keeferton, 3 Miles East of the Kanawha-Fayette County Line..... 560
XXX.—Old Method of Mining Formerly Used on Cabin Creek in Cherokee Mine, Cabin Creek Consolidated Coal Company 562
XXXI.—Present Method of Mining Coal in Cabin Creek Coal Field, Showing Projected Workings in Raccoon No. 2 East Mine, Cabin Creek Consolidated Coal Company, Kayford.. 566
Plates I and II illustrating Fossils described in Part IV on PALEONTOLOGY 654-655

Figures.

1. Map Showing County Reports Published and Under Preparation, also New Topographic Quadrangles..... XIV
2. Map Showing Location of Kanawha County..... XIV
3. Copper Gorget from Mound..... 16
4. Pipe from Mound, Kanawha County..... 16
5. Pipe from Mound, Butler County, Ohio..... 16
6. Sketch Showing Location of Mounds in Kanawha Valley.. .. 18
7. Enlarged Plan of Part of the Mound..... 20
8. Mound with so-called "Altar"..... 22
9. Map and Profile of Kanawha River..... 32
10. Map Showing Location of the Oil Wells in Blue Creek Oil Field 370
11. Diagram Showing the Relative Position of the Coals in Ka-Kanawha County..... 400
12. Map Showing Locations of Coal Openings and Mines in Kanawha County. (In Atlas under Separate Cover)..... ...
13. Showing Approximate Area of Available No. 5 Block Coal and Pittsburgh Coal in Kanawha County..... 410
14. Showing Approximate Area of Available Stockton-Lewiston Coal in Kanawha County..... 456

AUTHOR'S PREFACE.

In preparing this report, the main purpose has been to emphasize the most prominent features of the geology of the county, and to state the facts so that they can be easily understood both by residents of the county and State and geologists in general.

The ultimate purpose of this report is to assemble the present knowledge, including a large amount of unpublished data collected by the writer, his assistant and others in the field, not only of the general geology of the county, but a brief history of its settlement and growth, along with a description of the physiography and economic resources in the way of minerals and soils, and to present the facts in a form convenient to those who are interested in their study either for scientific purposes or for development.

The report gives (1) A brief history of the county and its development; (2) A study of its drainage system and other surface features; (3) The geologic structure with a contour map of the top of the Pittsburgh coal, for the western portion of the county, and the Kanawha Black Flint for the eastern part of the county; (4) Five chapters on the general geology and detailed stratigraphy, with a map showing the outcrop of the different divisions of the rock column, according to the generally accepted classification of geologists; (5) A description of the oil and gas fields therein, with suggestions for their future development, along with a map showing the accurate location of the oil and gas wells and dry holes; (6) Minable coals, with a table showing the chemical composition, calorific value and fuel ratio, and with a summary exhibiting the approximate available tonnage of the county; (7) Clays, road materials, building stones, forests and carbon black industry of the county; (8) A chapter on the soil and its products with suggestions for increasing the soil fertility; (9) An appendix showing railroad levels above tide at numerous localities in every portion of the county.

Special attention is called to the structure map accom-

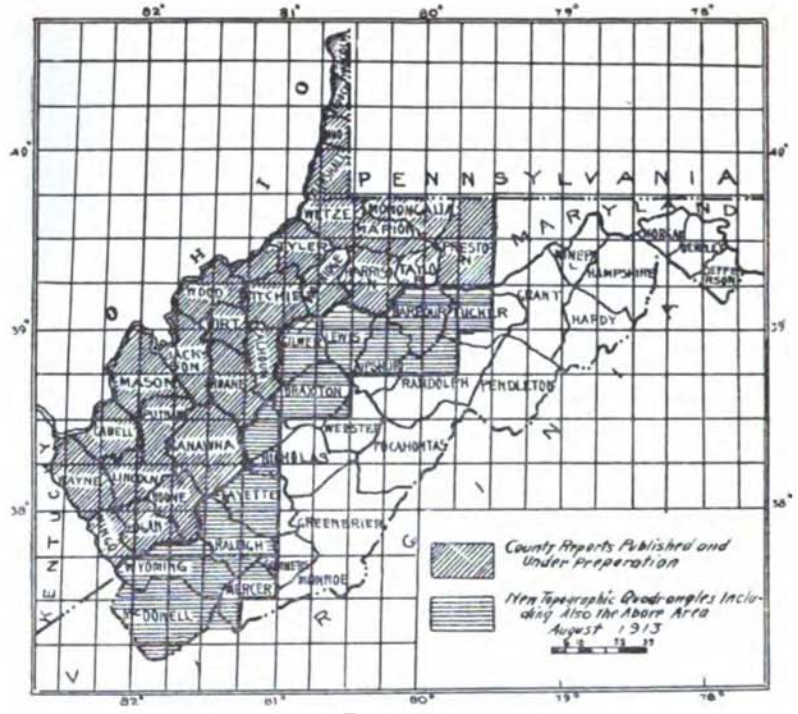

Figure 1.

Figure 2.

Fig. 1 and Fig. 2—County Reports Published and Under Preparation, and New Topographic Quadrangles. Map Showing Location of Kanawha County.

panying this report, whereon are shown by means of contour lines the tidal elevation of the Pittsburgh coal horizon at all points of the western part of the county and the Kanawha Black Flint in the eastern part of the county. These contour lines, separated by 25 feet in elevation, exhibit at a glance the approximate position of the horizon of this great coal bed, in the western part, and the Kanawha Black Flint in the eastern part of the county, as also the direction and location of the anticlines and synclines, as well as the **dip** and **strike** of the rock strata at any point, a knowledge of which is of great value not only for the future development of the oil and gas pools therein, but also for the future mining of the several coal seams where the latter are of minable thickness, purity and regularity. Special attention is also called to the several areas outlined by the writer as "Prospective Oil and Gas Territory," and the page references in the index under this heading by magisterial districts.

The chapters on the general geology and detailed stratigraphy, though quite technical, give a large fund of data about the formations of the Dunkard, Monongahela and Conemaugh, Allegheny and Kanawha series of the Carboniferous group of rocks. Therein some errors of correlation in former State reports are corrected, the writer ever keeping in mind the general and accepted classification of the rock strata which permits comparison with the formations in other portions of West Virginia.

The chapter on coal gives the thickness, character and general distribution of the several minable beds, along with an approximate estimate of the available area and tonnage of each vein with a final summary of the total available coal for the county. The commercial mines and openings are referred to in the table of analyses therein by serial numbers, the same corresponding to numbers assigned to the symbol designating the accurate location of the mine on the map referred to above.

Chapter XII gives a description of the clays and the clay industry, road materials, building stone, forests and carbon black industry.

The final chapter on the soil and its products, prepared by W. J. Latimer, of the Bureau of Soils of the Department of

Agriculture, well trained and versed in his profession, cannot fail to interest the progressive farmers of the county.

Three maps of the entire area accompany this report in a separate cover, one of which shows by appropriate symbols the character of the surface, the roads, streams, railroads, etc.; another by the same means the general and economic geology, with several items of special economic interest; and the third, in a similar way, the character, classification and distribution of the soil.

The writer and his assistant, D. D. Teets, Jr., spent the field season of 1912 in gathering data for this volume, and opportunity is here taken to mention that the accurate, painstaking and faithful discharge of all duties assigned to Mr. Teets, both in the office and in the field, has been of great assistance in the completion of this report.

Much valuable aid and assistance was given by residents of the area, as well as by officials of the several companies engaged in the development of the oil, gas and coal fields therein. Due credit and acknowledgment have been given in the text for all such data obtained.

The chemical analyses and heat determinations were made in the Survey laboratory by J. Berghuis-Krak, Assistant Chemist, under the supervision of B. H. Hite, Chief Chemist.

The writer also takes opportunity to express his obligations to I. C. White, State Geologist, whose writings and suggestions have added greatly to the value of the report.

C. E. KREBS.

Charleston, August 23, 1913.

INTRODUCTION

By I. C. White.

Kanawha county has had a most interesting history in the development of West Virginia's mineral industry. It was in this county at Charleston and vicinity that in boring for salt water, practically all of the tools, casing, and other implements used in drilling deep wells at the present time were invented. Here, too, natural gas was first utilized in America for manufacturing purposes, being burned in large quantities under the salt pans of the Kanawha valley, a few miles above Charleston as early as 1841, displacing 2,000 bushels of coal daily at one salt establishment.

The famous "splint" coals of the southwestern half of the State were first introduced to the commercial markets of the country from the mines of Kanawha county, so that the name "Kanawha Splint" has now become an established trade mark in all the great coal marts of the Middle West. In the development of the coal industry of the Kanawha valley, the late W. H. Edwards, the distinguished naturalist of Coalburg, Kanawha county, known all over the world through his beautiful and classic publications on "The Butterflies of North America," took a leading part, and it is very fitting that his son, the Hon. Wm. Seymour Edwards, should continue the work of keeping Kanawha county in the front rank along other lines of industry and science. To this son, more than to any other one man, Kanawha is indebted for its recent splendid oil and gas developments in the Blue creek and other regions of the county, and to his untiring energy, and love for pure science, the entire State is indebted for its deepest borng (5,595′), and which until recently remained the deepest drill hole in America, and the third deepest boring in the world. Hon. Wm. Seymour Edwards being always a pioneer, was the first man in the State to attempt to penetrate the earth to the deep lying Clinton or Medina oil and gas horizons of Ohio. The geologic formations, especially the Devonian shales, which overlie this deep petroliferous horizon, thicken rapidly south, and south-

eastward from the region of Bremen and other points in the State of Ohio, but nothing was known as to the rate of such thickening or whether or not it was possible to drill to the same horizon anywhere west of the Alleghanies in West Virginia until Mr. Edwards assumed the task of determining the matter, only a few miles distant from his home at Coalburg.

Through the courtesy of Mr. Edwards and the general manager of the Wm. Seymour Edwards Oil Company, Mr. Samuel R. Reynolds, the following record of this deep boring, on Slaughter creek, Cabin Creek district, Kanawha county, W. Va., is given to the public:

Record of the Slaughter Creek Coal & Land Company Well No. 1. drilled by the Wm. Seymour Edwards Oil Company, and located on Slaughter creek, one mile and a quarter south of the Kanawha river from Chelyan, about 15 miles above Charleston, W. Va.; Well mouth 640′ A. T. and 5 feet below the Peerless coal bed or top member of the Campbells Creek coal, and 490′ below the Kanawha Black Flint; Drilling began June 5, 1911; Completed late in 1912; Superintendent, J. V. Reishman; Drillers, J. M. Runnels and G. C. Clayton:

	Thickness Feet.	Depth Feet.	
Unrecorded (water at 50′)	55	55	
Coal, (Powellton)	5	60	
Sand	40	100	
Slate	10	110	
Sand	310	420	
Slate	15	435	
Sand, (gas at 450′)	105	540	
Slate	10	550	
Sand (Nuttall?)	90	640	
Slate	25	665	
"Salt Sand," (Raleigh?)	225	890	
Slate	2	892	
Sand, base of Pottsville Series	48	940	
Slate and lime	10	950	Mauch Chunk Series, 513′
Slate	25	975	
Lime shells	85	1060	
Slate	20	1080	
Lime	30	1110	
Slate	20	1130	
Sand (Hole filled with water at 1175′)	135	1265	
Red rock	5	1270	
Slate and shells	50	1320	
Red rock	15	1335	
Slate	55	1390	
Lime	35	1425	
Slate	5	1430	
Lime shells	3	1433	
Slate	5	1438	
"Little Lime" (Broken)	10	1448	
Pencil cave	5	1453	

	Thickness Feet.	Depth Feet.
"Big Lime," (Greenbrier) (Yellow, at 1490')	207	1660
Big Injun sand	36	1696
Slate	67	1763
Squaw sand (1st gas, 1830'; 2nd gas, 1843')	107	1871
Slate	222	2093
Berea sand	12	2105
Slate and lime	140	2245
Slate, sandy, with smell of oil at 2400' and 2690'; (Temperature, 113° F. at 4730')	2695	4930
Very black slate, (Marcellus)	5	4945
Lime (Corniferous), very hard, dark, flint nodules	90	5035
Clean yellow sand (Oriskany)	10	5045
Fine-grained gray sand (Oriskany)	5	5050
Lime, light gray (Temperature, 129° F. at 5230')	190	5240
Lime, dark	75	5315
Lime, light	40	5355
Lime, dark (water, 5592')	240	5595

Conductor, 16 feet.
10" casing, 37 feet.
8½" casing, 954 feet.
6⅝" casing, 1502 feet.

The well was cased at 1502 feet to shut off the "Pencil Cave" and the water from the Pottsville above, and it continued a dry hole to 5592 feet, where salt water was found in the "Big Lime" of the Ohio geologists at about the same geologic horizon where it occurs in Ohio, and this **salt water** evidently comes from near the base of the **Salina beds** which hold **rock salt** in Northern Ohio, Western New York, and which was struck in the Derrick City deep boring, 4 miles east of Bradford, Pa., at a depth of 4490 feet, 390 feet below the top of the Corniferous Limestone and extended to a depth of 4713 feet through an interval of 223 feet, of which 87 feet was pure salt, in beds of 30, 10 and 47 feet each at depths of 4490, 4596, and 4638 feet respectively, with a mixture of salt and shale 20 feet thick at 4693 feet, ending at 618 feet below the top of the Corniferous Limestone, as against 647 feet below the top of the same horizon for the salt water in the Edwards or Slaughter creek well. The water rose in the well to about 4000 feet from the bottom, and the slates above the Corniferous Limestone caved so badly that further progress in drilling seemed

impossible without shutting off the water. This would have required more than a mile of 4¼" casing, and would have reduced the bore hole to such small dimensions that Mr. Edwards concluded the chances of reaching the Clinton oil and gas horizon of Ohio (the intended goal of the well) were so hopeless that he reluctantly abandoned further drilling. Then, too, the water in the well appeared to be very corrosive upon the tools, and everything of metal connected with the drilling operations, and hence it was feared that any casing inserted to shut off the water would be destroyed and its purpose defeated.

It is of interest to make some comparisons of this deepest well in West Virginia with the Geary deep well, now being drilled by the Peoples Natural Gas Company—a Standard Oil Company subsidiary of which Mr. J. G. Pew of Pittsburgh, Pa., is President—5 miles northwest of McDonald, Pa., which has already attained a depth of nearly 6500 feet and is the deepest well in America, being surpassed by only one other boring in the world, viz., the one near Czuchow in Silesia, which reached a depth of 7349 feet, and had a temperature of 182° F. at 7287 feet.

No temperature readings below 6270 feet, where the temperature of the water was 156° F., have been taken in the Geary well.

In the Slaughter creek well two determinations were made by Mr. John Johnston for the U. S. Geological Survey, the results of which have kindly been placed at the disposal of the W. Va. Geological Survey by Dr. Geo. Otis Smith, Director, as follows:

At 4730 feet, approximately.....113° F.
At 5230 feet, approximately.....129° F.

The determinations were made with the apparatus and thermometers of the late Dr. Hallock, loaned by him to the U. S. Geological Survey a short time before his death, and are the same with which he made the careful determinations of earth temperatures in the Wheeling, W. Va., and West Elizabeth, Pa., deep wells. The Wheeling well stopped at 4500 feet, where the temperature was 110.3° F., which would agree closely with 113° in the Slaughter creek well at 4730 feet.

In the Geary well the temperature at 5220 feet as reported by Capt. Barger was 120° F., but in the Slaughter creek well at 5230 feet or nearly the same depth, a temperature of 129° F. was measured, a difference of 9° F. at practically the same depth in the same geologic formations. The presence of a slight quantity of natural gas in the Geary well at very great depths and under enormous rock pressures, however, may have tended to reduce the temperatures found therein, since although a temperature of 140° F. is reported there at 5800 feet, the thermometer recorded only 100° F. at 6000 feet in the presence of a slight flow of gas at that depth. In the West Elizabeth deep well where some natural gas was also escaping from the walls of the unlined boring, a temperature of 120° F. was recorded by Dr. Hallock at a depth of 5010 feet and of 127° F. at 5380 feet, both of which are probably a few degrees lower than they would have been except for the escape of natural gas into the hole during the time the temperatures were in process of recording, so that the temperature of 129° F. in the Slaughter creek well at a depth of 5230 feet is probably more reliable than any of the others unless it be the temperature of 156° F. for the water in the Geary well at 6260 feet, which ought to have given fairly accurate results, since the gas would not have been escaping to any appreciable extent through the great column of salt water (5560′).

The character of the salt water in the McDonald and Slaughter creek wells, the former found in a sandstone (Oriskany and Lower Helderberg) at 6260 feet, 252 feet below the top of the Corniferous Limestone, and the latter probably in the Salina Limestones at a depth of 5592 feet, and 647 feet below the top of the Corniferous Limestone, is shown by the following analyses. The analysis of the water from the Slaughter creek well was made by Mr. Chase Palmer in the laboratory of the U. S. Geological Survey, through the courtesy of whose Director the results have been furnished to the W. Va. Geological Survey. The two analyses are expressed in different terms and quantities, but they can be readily translated into equivalent terms:

Slaughter Creek Well.

Water from 5592'
Approximate Analysis.
Contents of 100 grains of water.

Na_x	4.5600
Ca	2.2300
Mg	0.3800
Cl	12.0800
S	0.0224
CO_3	0.0015
	19.2739

"The solution showed no radio-activity. Sp. gr. equals 1.1595."

McDonald (Geary) Well.

Water from 6260 feet, by H. H. Graver, Chief Chemist, Pittsburgh Testing Laboratory:

Specific gravity at 60° F.	1.1085
Oil	Trace
	Parts per 100,000
Alkalinity as calcium carbonate	5.50
Calcium chloride	4,421.40
Magnesium chloride	251.60
Sodium chloride	5,018.20
Sulphuric anhydride	Trace
Iron oxide	Trace
Sediment (rock powder)	224.00
Total solids	9,921.30
Total solids exclusive of rock sediment	9,696.70

A comparison of the two results will show nearly double the amount of solids in the water derived from the limestone in the Slaughter creek well, over that from the sandstone in the McDonald well—a result not at all surprising, and both analyses may be regarded as throwing some light on the composition of the Paleozoic ocean waters.

The interval between the Berea Sand and the Corniferous Limestone in the Slaughter creek well is 2840 feet as against 1005 feet in the Central City boring on the Ohio river near Huntington, Cabell county, 55 miles W. N. W. which gives an E. S. E. thickening rate of about 33 1/3 feet to the mile. This thickening of 33 1/3 feet to the mile between the Central City well on the Ohio river and the Slaughter creek well on the Kanawha river, shows only a slight excess in the rate of thick-

ening over that in the 80 miles between Akron, Ohio, and the R. A. Geary deep well near McDonald, Pa., where these same Devonian beds between the Berea Sand and the Corniferous Limestone thicken from 1862 feet at Akron to 4386 feet; 80 miles southward in the Geary well near McDonald*.

The elevation of the top of the Corniferous Limestone in the Slaughter creek well is 4305 feet below tide, while the same geologic horizon in the Geary well is 4950 feet below tide, or 645 feet lower. In the Geary well the Pittsburgh coal crops at 130 feet above the mouth of the same, thus making the interval between it and the Corniferous Limestone (130′+6008′), 6138 feet. In the Slaughter creek well the Pittsburgh coal horizon would come about 1290 feet above the well, and thus make the Pittsburgh coal to Corniferous Limestone interval (1290′ +4945′), 6235 feet, or practically the same as in the Geary well, the difference being only 97 feet, a remarkable fact when we consider that the Devonian beds between the Berea Grit and the Corniferous Limestone in the Geary well have a thickness of 4386 feet, while in the Slaughter creek well the same beds are only 2840 feet, or 1546 feet less. This extra sedimentation in the Devonian beds of the McDonald region appears to have been finally compensated in the Slaughter creek region, although at a much later date, and largely during Pottsville time, since the latter series is only about 250 feet thick in the Geary bore hole, while on Slaughter creek the boring begins about 575 feet below the top of the Pottsville, and as its base was reached at 940 feet, the resulting Pottsville thickness is 1515 feet, an expansion of 1265 feet over the thickness (250′) of the Pottsville at McDonald. Then, too, the Mauch Chunk series, including the Greenbrier Limestone, which is only 42 feet thick in the Geary deep well, has expanded to (1660′— 940′) 720 feet in the Slaughter creek boring, so that if we compare the intervals between the Pittsburgh coal and the top of the Big Injun oil sand or base of the Greenbrier Limestone in each well, we find this interval at Slaughter creek (1290′+ 1660′) 2950 feet, while the same interval is only (130′+953′), 1083 feet in the Geary well near McDonald, 170 miles north-

*Bulletin of the Geological Society of America Vol. 24. p. 278. Note on a Very Deep We'l Near McDonald, Pennsylvania, by I. C. White.

eastward, a difference of (2950'—1083') 1867 feet, which is only (1867'—1546') 321 feet more than the excess of Devonian shales and sandy beds at McDonald over the thickness of the same formations at Slaughter creek (4386'—2840'=1546'), thus showing that the compensation for rapid sedimentation in Devonian times throughout the McDonald region took place in the Slaughter creek region during Mississippian and Pottsville time. From what is known of the reduced thickness of Devonian sedimentation southwestward from Pennsylvania along the Alleghany mountain region, and the great increase in Pottsville, Mauch Chunk and Greenbrier deposition, it is probable that the deficiency of the former was practically compensated by the excess of the latter over the southwestern portion of the Alleghany Mountain plateau, since in Summers, Monroe and Greenbrier counties of West Virginia, the Mauch Chunk series attains a thickness of nearly 3500 feet, the Greenbrier, 1300 feet, and the Pottsville, about 2500 feet, while in the same region the Catskill series, which exhibits such a great thickness in Maryland and Pennsylvania, along the central Appalachian plateau, has practically disappeared from the geologic column through the loss of all of its red beds under the counties mentioned, as exposed in the gorges of the New and Greenbrier rivers.

The general section of the Kanawha series given in this report had already been printed as well as most of the volume when the studies of Messrs. Hennen and Reger in Logan and Mingo counties, and the studies of Messrs. Krebs and Teets in Boone county during the year 1913 revealed the fact that the section of the Kanawha series would need some revision based upon the more detailed geologic work now possible with the aid of accurate field maps and elevations.

These Assistants of the Survey, led by Mr. Hennen, have traced the several coal beds from Mingo and Logan counties across Boone and Kanawha to the Kanawha river, and Mr. Hennen has prepared a revised section of the Kanawha series based upon the results thus obtained. In this tracing of the formations they were greatly aided by an impure limestone full of marine fossils which was first discovered at Dingess, Mingo county, by Assistant D. B. Reger and named from that

locality. It was later traced along Tug river by Ray V. Hennen from the region of Naugatuck to Ma'ewan, 25 miles above, and thus its persistence in the section was established. It carries a well marked fauna which Dr. Price, the Paeleontologist of the Survey, is studying, and these fossils appear to be present in the sandy shales and shaly sandstones at the proper horizon even when the **limestone** as such is absent at many localities where the Dingess horizon is exposed between the Kanawha and Tug rivers. The Eagle Shales and Limestone horizon of the Kanawha river with its rich marine fauna, discovered and named by the writer in 1884, was also found to carry its fossils into Boone county and across to the Tug river in southern Mingo, and thus it, too, greatly aided in getting correct identifications and correlations through from Logan and Mingo to the Kanawha river.

A third **limestone** filled with marine fossils has been observed by the writer near the mining village of Winifrede at about 65 feet below the famous Winifrede coal bed. This as given in Vol. II(A), W. Va. Geological Survey, page 431, will probably prove a fossiliferous horizon at other localities when the exposures can be studied, and since the Campbells creek limestone overlying the coal of the same name contains marine fossils occasionally as observed by Assistant Krebs, there are at present five known horizons for **marine fossils** that have been definitely located in the Kanawha series of Kanawha, Boone, Logan and Mingo counties, thus indicating that this series of coals at least was accumulated along the margin of an ocean or gulf whose tidal flats and swamps were subject to incursions of marine waters throughout the deposition of more than 1,000 feet of sediments, since the "Kanawha Black Flint" near the top of the Kanawha series always contains marine fossils.

The revised section of the Kanawha series as prepared by Assistant Hennen for Kanawha county, and which with greater intervals (since they all increase southwestward from the Kanawha river) will also answer in a general way for Logan and Mingo counties, is as follows:

General Section, Kanawha Series—Kanawha County.

By Ray V. Hennen.

		Thickness Min. Ft.		Max. Ft.	Total Ft.	
1.	**Sandstone, Homewood**	40	to	60	60	
2.	Shales, sometimes holding coal	0	to	20	80	
3.	**Kanawha Black Flint**, with marine fossils	0	to	10	90	90'
4.	Shale	5	to	15	105	
5.	**Coal, Stockton**, always multiple, and in 2 to 4 divisions separated by shales	5	to	10	115	25'
6.	Sandy shale or impure fire clay	10	to	20	135	
7.	**Sandstone, Upper Coalburg**, coarse, massive gray, often weathering into "Chimney rock" columns on summits	50	to	60	195	80'
8.	**Coal, Coalburg**, multiple, splinty	5	to	10	205	
9.	Shale	5	to	15	220	
10.	**Coal, Little Coalburg**	1	to	2	222	
11.	**Sandstone, Upper Winifrede**, massive, yellowish gray	40	to	55	277	
12.	**Coal, Winifrede**, multiple-bedded	4	to	8	285	90'
13.	Shales and impure fire clay	1	to	3	288	
14.	**Sandstone, Lower Winifrede**, grayish white, hard, often massive and resting with local unconformity on the underlying beds	30	to	50	338	
15.	**Coal, Chilton "A,"** double bedded, splinty	1	to	2	340	55'
16.	Fire clay, impure, and shale	5	to	19	359	
17.	**Limestone, Winifrede**, impure, fossil shells, many Producti	½	to	1	360	
18.	**Sandstone, Upper Chilton**, dull gray, medium grained, micaceous	20	to	40	400	
19.	**Coal, Chilton**, double-bedded, splinty, same as mined on Spruce fork, Dingess run, Rum and Buffalo creeks, Logan county, and once mined just east of Dingess and at Naugatuck, Mingo county	2	to	5	405	65
20.	Fire clay, impure	0	to	8	413	
21.	**Sandstone, Lower Chilton**, dull gray, micaceous	10	to	25	438	
22.	**Coal, Little Chilton**, double-bedded, splinty	1	to	2	440	35'
23.	Fire clay, impure	0	to	6	446	
24.	**Sandstone, Hernshaw**	15	to	25	471	
25.	**Coal, Hernshaw**, double-bedded, splinty and same as "Black Band" on Lens creek, Kanawha county	2	to	4	475	35'
26.	Shale, and horizon of Naugatuck sandstone of Mingo county	15	to	19	494	
27.	**Coal, Dingess**, gas type, same as once mined at Dingess	½	to	1	495	20
28.	Shale	5	to	10	505	
29.	**Sandstone, Williamson**	10	to	25	530	
30.	Shale	0	to	6	536	

		Thickness Min. Ft.	Max. Ft.	Total Ft.	
31.	**Limestone, Dingess,** silicious, lenticular, ferriferous, many Productl and other marine forms	0 to	2	538	
32.	Shale, dark green, sandy, with iron ore nodules and plant fossils	10 to	20	558	
33.	**Coal, Williamson,** multiple bedded, splinty, same as mined at Williamson, Mingo county, and upper seam mined by Auburn Coal Co., 1 mile above Matewan on Kentucky side of Tug	1 to	2	560	65'
34.	Fire clay, impure, and shale	0 to	5	565	
35.	**Sandstone, Upper Cedar Grove,** dull gray, massive, medium grained, micaceous	10 to	20	585	
36.	Shale, dark gray with iron ore nodules and plant fossils	10 to	20	605	
37.	**Coal, Cedar Grove,** both gas and splinty, double-bedded; same as **Island Creek** bed of Logan county, and split into the **Upper** and **Lower Thacker** on Mate creek, Mingo county	3 to	5	610	50'
38.	Fire clay, impure	1 to	3	613	
39.	**Sandstone, Lower Cedar Grove**	10 to	20	633	
40.	Shale, dark gray, with iron ore nodules and plant fossils	5 to	15	648	
41.	**Coal, Alma,** some splint, mostly gas type, multiple-bedded, mined at Spring and Rawl, Mingo county; same as **Draper** vein at Logan and as mined at Big Creek, Logan county; and at Ramage, Boone county	1 to	2	650	40'
42.	Fire clay, impure, and shale	1 to	5	655	
43.	Sandstone Logan, bluish gray, massive medium grained	10 to	20	675	
44.	Shale	0 to	4	679	
45.	**Coal, Little Alma,** double-bedded, crops near mouth of Armstrong creek	0 to	1	680	30'
46.	Fire clay, impure	0 to	4	684	
47.	Sandstone, Malden	15 to	25	709	
48.	Shale, gray, flaggy and sandy	0 to	5	714	
49.	**Limestone, Campbells Creek,** silicious, lenticular, dark gray, hard, the horizon carrying **marine fauna** at Bald Knob, Boone county	0 to	2	716	
50.	Shale, dark gray, with iron ore nodules and plant fossils	10 to	20	736	
51.	**Coal, Peerless,** gas type, split off top of Campbells Creek bed	2 to	4	740	
52.	Shale	0 to	20	760	
53.	**Coal, No. 2 Gas,** multiple-bedded, gas type, main bench of **Campbells Creek coal;** and including Peerless is same as mined in Logan county at Manbar, and lowest bed operated on Buffalo creek; and in Mingo county is known as the "Warfield" "Burnwell," "Freeburn," "Rawl,"				

		Thickness Min. Ft.	Max. Ft.	Total Ft.	
	and "Upper War Eagle".....	3 to	10	770	90'
54.	Fire clay, impure and shale.....	0 to	5	775	
55.	**Sandstone, Brownstown**.....	20 to	35	810	
56.	Shale	1 to	5	815	
57.	**Coal, Powelliton**, double-bedded, same as "Hatfield Tunnel" of Mingo county....	1 to	5	820	50'
58.	Fire clay, impure, and shale, sandy and flaggy	40 to	58	878	
59.	**Limestone, Stockton**, silicious, lenticular, hard, dark gray.....	0 to	2	880	60
60.	Shale	30 to	40	920	
61.	**Coal, Eagle "A,"** double-bedded, gas type, exposed near mouth of Armstrong creek..	0 to	2	922	
62.	Sandstone, Eagle.....	10 to	22	944	
63.	**Coal, Eagle**, soft, gas type, same as "No. 1 Gas" of Kanawha valley, and "Middle Eagle" of southern Mingo county.....	2 to	6	950	70'
64.	Fire clay.....	0 to	3	953	
65.	Sandstone, Decota, massive.....	0 to	25	978	
66.	**Coal, Little Eagle**, double-bedded, gas type. and lower division once mined commercially at Cedar, Mingo County.....	1 to	2	980	
67.	Fire clay and shale.....	0 to	3	983	
68.	**Sandstone, Grapevine**, massive, type locality, mouth of Grapevine creek, Mingo county; observed at mouth of Armstrong creek.....	0 to	10	993	
69.	Shale, sandy.....	10 to	30	1023	
70.	Black slate.....	2 to	10	1033	
71.	Limestone, Eagle, dark gray. hard, marine fossils	1 to	2	1035	
72.	**Shale, Eagle**, dark, marine fossils.....	1 to	5	1040	
73.	Shale and sandstone, holding **Lower War Eagle and Glen Alum Tunnel coals** of Mingo county to top Nuttall sandstone and base of Upper Pottsville Series.....150 to		200	1240	

This section should be used by the reader instead of the one given on pages 212-214 of this Report in all questions of identity and correlation.

ERRATA.

Page 28, line 17: for "Kanwha," read "Kanawha."
Page 41, line 38: Read thus, " * * then 4 miles as a dividing line between Lincoln and Kanawha counties."
Page 54, line 20: for "is" read "in."
Page 136, line 23: for "Bakertown," read "Bakerstown."
Page 146, lines 3 and 5: for "Clendennin," read "Clendenin."
Page 148, lines 9 and 11: for "Aaron P. O.," read "Aarons P. O."
Page 220, line 16: for "Winfrede," read "Winifrede."
Page 240, line 41: for "ot," read "to."
Page 583, line 14: for "plug," read "pug."

PART I.

The History and Physiography of Kanawha County.

CHAPTER I.

THE HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION AND HISTORY.

The portion of the State of West Virginia discussed in detail in this report, Kanawha county, lies between the parallels of 37° 50′ and 38° 40′ North latitude, and the meridians 81° 10′ and 81° 55′ West longitude from Greenwich.

GENERAL DESCRIPTION.

Kanawha county lies southwest of the central part of West Virginia and is divided by the Kanawha river, running in a northwest direction through the entire county. It is bounded on the north by Jackson and Roane counties; on the east by Roane, Clay, Nicholas and Fayette counties; on the south by Raleigh and Boone and on the west by Boone, Lincoln and Putnam counties.

Its area given by districts as computed from the accurate topographic sheets of the U. S. Geological Survey is as follows:

Districts.	Sq. Miles.
Big Sandy	80.28
Charleston	14.91
Cabin Creek	237.21
Elk	165.49
Jefferson	40.24
Loudon	83.30
Malden	64.74
Poca	87.84
Union	85.27
Washington	55.11
Total	914.39

The general surface of the country varies in elevation from 542 feet above tide where the county line crosses the Kanawha river to 2650 feet above tide at the summit of a high knob on the Kanawha-Raleigh county line, a range in elevation of 2008 feet.

The population in 1900 was 54,696, of which 50,711 were white, 3,985 colored and 744 foreign born. The census of 1910 gives the total population as 81,457, an increase of nearly 50 per cent. This increase is due to the fact a large number of mines has been opened in Cabin Creek district and the rapid growth of Charleston.

The following table shows the changes in population of the county by districts during the last twenty years as given by the census of 1910:—

Districts	Population.		
	1910	1900	1890
Big Sandy	3,835	2,915	1,960
Charleston	23,966	13,417	10,222
Cabin Creek	22,920	11,854	7,940
Elk	6,391	5,665	4,374
Jefferson	3,841	3,545	3,270
Loudon	5,718	4,427	3,343
Malden	3,803	3,364	3,707
Poca	4,090	3,818	3,038
Union	3,949	3,842	3,266
Washington	2,944	1,849	1,636
Total	81,457	54,696	42,756

The figures given above show that the population of the county has increased nearly 100% in the last 20 years, but this increased population was principally in Charleston and Cabin Creek districts, due to the fact that Charleston district con-

tains the City of Charleston, and Cabin Creek district contains the principal mining industry of Kanawha county. The remaining districts contain farming and grazing land and thus show very little increase in population.

Kanawha county began its existence in November, 1788, having been formed, by legislative enactment, from parts of Montgomery and Greenbrier counties, and was named from the Kanawha river which flows through the county in a northwestern direction. The county, as first formed, had the following boundary lines:

"Beginning at the mouth of Great Sandy in the said county of Montgomery, thence up the said river with the line of the said county to the mountain generally known by the name of Cumberland Mountain, thence a northeast course along the said mountain to the Great Kanawha, crossing the same at the end of Gauley Mountain, thence along the said mountain to the line of Harrison county, thence with that line to the Ohio river, thence down the said river including the islands thereof to the beginning."

This area comprises parts of fifteen of the counties in the southwestern part of the State, which have been formed from Kanawha county.

The farming land of Kanawha county is well adapted to both tillage and grazing. It is one of the richest counties in the State in the production of petroleum and natural gas, and the pools of these hydro-carbons are still undergoing development. It is also richly underlaid with coal, and is one of the foremost mining counties in the State. Its principal products are corn, wheat, oats, hay, beef cattle, sheep, hogs, poultry, fruits, coal, petroleum, natural gas, and manufactured articles, such as coke, carbon black, glassware, axes, salt, tools and bricks.

The quality and character of the soil and its products, as well as the mineral wealth, will be discussed in detail in subsequent chapters of this report.

The State Auditor gives the following property valuations for Kanawha county for the year 1912:

	Assessed Valuation	State Tax
Real Estate	$27,513,958.00	$2,751.40
Personal Property	11,124,540.00	1,112.45
Total	$38,638,498.00	$3,863.85

The School tax of Kanawha County for the year 1912, as given in the records of the Sheriff's office, was as follows:

Teachers' Fund	$126,088.99
Building Fund	56,647.53
Total	$182,736.52

The levy for the municipal tax for the city of Charleston for 1912 was at the rate of 54 cents per $100 valuation, and the assessed valuations are given in the following table:

	Assessed Valuation	Municipal Tax
Real Estate	$15,751,710.00	$ 85,059.23
Public Utilities	30,698,036.00	165,769.39
Personal Property	6,244,440.00	33,719.97
Total	$52,694,185.00	$284,548.59

The County tax is 25 cents on each $100 valuation, and this together with the State, Municipal, Public Library and other taxation, makes the rate in the city of Charleston for the year 1912, $1.35½ on each $100 valuation.

The principal cities and towns of Kanawha county are as follows: Charleston, Saint Albans, Clendenin, East Bank, Cedar Grove, Malden, Dana, Putney, Ward, Mammoth, Marmet, Winifrede, Coalburg, Kayford, Eskdale, Dakota, Carbon, Spring Hill, Dunbar, Sissonville, Bream, Blue Creek, Quick, Sproul, Dungriff, Olcott, Brounland, Hernshaw, Sattes, Lock Seven, London, Hugheston, Guthrie, Wallace, Blundon, Hunt, Wellford, Weir, Queen Shoals, Morris, Ronda, Dry Branch, Sharon, Mucklow, Burnwell, Handley, Crown Hill, Hansford, Cabin Creek Junction, Chelyan, Kanawha and South Ruffner.

Charleston.

Charleston is the third largest city in West Virginia, and is located on Kanawha river at the mouth of Elk river. It is the capital of West Virginia and the county seat of Kanawha county. It is built on the second terrace, or old erosion level of these two streams. The first settlement was made in 1788 by George Clendenin.

PLATE II.—Charleston in 1854, taken from an old painting.

Charleston was established by an act of the Assembly, December 19, 1794.

"It was enacted that four acres of land, the property of George Clendenin, at the mouth of Elk river, in the county of Kanawha, the same as laid off into lots and streets, shall be established as a town by the name of 'Charlestown,' and Reuben Slaughter, Andrew Donalley, Sr., William Clendenin, John Morris, Sr., Leonard Morris, George Alderson, Andrew Baker, John Young and William Morris, gentlemen, are appointed trustees."

Hon. John P. Hale, the historian of the Kanawha valley, has the following to say in regard to Charleston:

"On the 19th day of December, 1794, the legislature of Virginia formally established the town and fixed its name as 'Charlestown.' It is a curious fact that, although the legislature had officially established the county, in 1789, as 'Kenawha,' and now the town, in 1794, as 'Charlestown,' both names by common consent became changed—one to 'Kanawha' and the other to 'Charleston.' How, why or when nobody knows. Some years ago there was much trouble and annoyance about our mail matter, growing out of the confusion of the Postoffice names of our Charleston and Charlestown, Jefferson county. With a view to remit this, a public meeting was called here to discuss the propriety of changing the name of our town from Charleston to 'Kanawha City.' It was warmly discussed and defeated."

During the last decade Charleston has had a very rapid growth both in population and industrial activity. The census of 1900 gives the population as 11,099, but that of 1910 gives it 22,996, or a gain of 11,897. This is a growth of 108 per cent and ranks Charleston as the third city in population in the State.

A short account will now be given of the several industries of Charleston and vicinity:

The Kelly Axe Factory.—This plant is located on the West side near the mouth of Kanawha Twomile, and was established in 1905. It covers about 30 acres of land and produces more than one-half of the axes manufactured in the United States. Mr. J. C. Kelly is president and general manager. The plant employs from 800 to 1000 skilled workmen and laborers.

South Side Foundry and Machine Works.—This plant is located on the south side of Kanawha river, and was established by O. O. and W. T. Thayer in 1890. It manufactures all kinds of machinery used in connection with the mining of coal and coal tipples. Mr. G. T. Thayer is General Manager

and Treasurer, and employs 10 skilled workmen and 30 laborers.

The Charles Ward Engineering Works.—This plant is located on the south side of Kanawha river near the Chesapeake & Ohio Railway depot, and was established in 1873. It manufactures marine boilers, and employs 30 skilled workmen and laborers.

The Kanawha Mine Car Company.—This factory is located on the Kanawha & Michigan Railroad near the eastern end of Thompson street, and was established in 1902. It manufactures mine cars and all kinds of mine supplies, and employs 60 skilled workmen and laborers. Mr. M. T. Davis, Jr., is the General Manager.

The Vulcan Iron Works.—This plant is located on west side of Elk river, on Virginia street, and manufactures all kinds of mine supplies, employing 20 skilled workmen and laborers.

West Virginia Clay Products Company.—This plant is located on the south side of Elk river on the Coal & Coke railroad near the mouth of Twomile. It was established in 1912, and manufactures all kinds of building brick. The fire clay used occurs just under the Buffalo sandstone near the base of the Conemaugh series. Seventy men are employed, according to the statement of Mr. Kay, the General Manager.

Baldwin Steel Company.—This plant is located on south side just west of the railroad bridge across the Kanawha river. It was established in 1907, and reorganized in 1912, with Joseph Krieg as President and Treasurer, and Anton Boerder as Vice-President, Secretary and General Manager. It manufactures, according to Mr. Boerder, the following:

"CLAY, CRUCIBLE STEEL CASTINGS; Automobile and alloyed castings a specialty, gears, sprockets, axles, cylinders, 'Hudson,' Baldwin High Speed Steel, 'Ajax' self-hardening steel, 'Baldwin' crucible cast tool steel, 'Extra' Baldwin Die Steel 'Special,' Spring and Machinery steel, Billets, Ingots, and Forging in all grades of steel Chrome, Nickel, Vanadium Steel. Manufacturers and exporters of steel for all purposes. Annealed and unannealed sizes at warehouse. Non-magnetic steel for electric car apparatus."

The plant employs 225 workmen, and has a minimum daily output of 650 tons, and ships the finished product to different parts of the United States, England and France.

Standard Brick Company.—This factory is located on the

PLATE III.—Birdseye view of Central Portion of Charleston, 1913.

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Kanawha & Michigan railroad west of Twomile creek, and manufactures paving, building, and fire proof brick. Mr. H. C. Kenyon is Superintendent and Mr. F. M. Staunton is President. The principal production is building brick. The clay is from the shale occurring between the Connellsville and Morgantown sandstones, possibly the Clarksburg Reds, and it makes an excellent brick. According to Mr. Kenyon, the plant has a daily capacity of 50,000 brick and employs 70 men.

Charleston Manufacturing Company.—This is located at the corner of Charleston street and Pennsylvania avenue, and is one of the most important manufactories of its kind in the Kanawha Valley. The plant manufactures overalls and shirts for working men, employing about 100 laborers. W. A. Abney is President, E. A. Barnes, Secretary, and A. L. Davis, General Manager.

Banner Window Glass Company.—This factory, of which Lewis Waterloo is President, is located in South Charleston on Eastern avenue near D street. The plant was established in 1907, the glass sand used being shipped from Lawton, Ky., and the lime, from Marble Cliff, Ohio. Forty-seven skilled workmen and 43 laborers are employed and the output is 7200 boxes monthly, a box containing 50 sq. ft.

Charleston Window Glass Company.—This window glass works is located on the Kanawha & Michigan Railroad near Twomile creek. It manufactures a fine quality of window glass, employing 50 skilled workmen and 90 laborers. The plant was established in 1910, and Mr. Albert Gilbert is the President. The glass sand used is shipped from Limestone, Ky.

Charleston has a large number of wholesale houses distributing groceries, dry goods, hardware, machinery, etc.

Among the wholesale grocers are: Ruffner Brothers, Lewis-Hubbard & Company, and Hubbard Grocery Company. Dry goods wholesale firms are the following: Abney-Barnes Company, Noyes-Thomas & Co., Schwabe Clothing Company The Charleston Hardware Company, Loewenstein & Sons, Goshorn Hardware Company and W. F. Shawver Company are among the firms distributing hardware through the terri-

tory adjacent to Charleston. The Payne Shoe Company and Thomas Shoe Company are wholesale shoe houses.

Charleston is also a strong financial center, as shown by the financial statement of the various banks of the city made April 4, 1913, as follows:

April 4, 1913	Capital and Surplus.	Deposits.
Kanawha Valley Bank	$1,028,730.52	$ 3,089,954.94
Charleston National Bank	1,031,929.21	1,770,934.53
Kanawha Banking & Trust Co.	486,935.84	1,163,692.08
Kanawha National Bank	380,055.32	1,155,229.17
Citizens National Bank	294,250.48	1,238,537.40
National City Bank	154,954.27	815,688.72
Capital City Bank	237,327.65	438,717.74
Charleston-Kanawha Trust Co.	168,637.80	272,975.14
Elk Banking Company	65,411.89	213,989.17
Peoples Exchange	42,427.14	130,456.42
Glenwood Bank	30,327.43	39,075.99
Totals	$3,920,987,55	$10,329,251,30

The Union Trust Company with capital of $500,000 began business in May, 1913.

A statement issued by the banks of Charleston on April 9, 1903, or ten years before, shows the following:

April 9, 1903	Capital and Surplus.	Deposits.
Kanawha Valley Bank	$ 468,905.11	$1,687,788.17
Charleston National Bank	504,206.12	1,332,034.13
Citizens National Bank	166,606.67	698,082.99
Kanawha National Bank	154,805.07	622,400.60
Kanawha Banking & Trust Co.	345,102.14	503,519.78
Totals	$1,639,625.11	$4,843,825.67

It will be seen from this statement that the number of banks has increased from five in 1903 to twelve in 1913; that the capital and surplus of local banking institutions has increased approximately 115 per cent and that the total amounts of deposits in the banks of the city has increased more than 120 per cent in the same length of time.

Saint Albans.

Saint Albans is situated on the Kanawha river at the mouth of Coal river, 12 miles west of Charleston, on the Main

PLATE IV.—State Capitol Building, Charleston, W. Va.

Line of the Chesapeake & Ohio Railroad and at the junction of the Coal River Branch of said railroad. The population in 1900 was 816 and in 1910 was 1,209, showing an increase of about 50 per cent. Saint Albans has two banks, 33 stores, 6 churches, and 2 schools.

The town was incorporated in 1868 by an act of the legislature under the name of Kanawha City, but a short time afterwards the name was changed to Saint Albans. It was named in honor of Saint Albans, England, by an associate of the late C. P. Huntington.

Saint Albans has several lumber plants located within its limits, among which are the following:

American Column and Lumber Company, Bowman Lumber Company, and Geo. Weimer and Sons.

East Bank.

East Bank is situated on the Kanawha river, 18 miles southeast of Charleston, in the coal mining region of Kanawha county. It has 8 stores, 3 churches, one school house and a high school. Its population in 1900 was 468, and in 1910, 551, showing very little growth in the past decade.

Cedar Grove.

Cedar Grove is located on the north bank of the Kanawha river at the mouth of Kelly creek, 18 miles south of Charleston. It is a mining town and is located at the junction of two branch railroads running up Kelly creek. The population in 1910 was 679. It was incorporated in 1902, and has 8 stores, 3 churches, and 2 schools. It also has 2 manufacturing plants —one Glass, the other Carbon Black.

Pratt.

Pratt is located on the south bank of the Kanawha river, at the mouth of Paint creek, 22 miles southeast of Charleston. The town was originally laid out in 1850 under the name of Clifton, and incorporated June 4, 1905. The name was then changed to Dego, and in 1889 was again changed to Pratt, its

present name, in honor of Charles Pratt who owned a large area of coal land on Paint creek. Pratt is a mining town, and its population in 1910 was 306.

Handley.

Handley is located on the Chesapeake & Ohio Railroad, 24 miles east of Charleston. It is a mining town and claims a population of about 1,000. The Chesapeake & Ohio Railroad has made Handley the end of the New River division, and has extensive yards there and a round house for its locomotives. The railroad company erected a Y. M. C. A. building in 1906 which contains lodging rooms and a large reading room, with a restaurant open day and night. The town contains two churches, seven stores and two schools.

Marmet.

Marmet is situated on the Kanawha river at the mouth of Lens creek, 10 miles east of Charleston. The town was first named Brownstown in honor of Charles Brown, a man who was interested in salt manufacturing there. The town was incorporated in 1913. Its name was changed to Marmet about 1905 in honor of the Marmet Coal Company, which operates mines at Hernshaw, 3 miles up Lens creek, and has extensive docks on the Kanawha river at Marmet for loading coal into barges for transportation to the Cincinnati and other lower river markets.

Malden.

Malden, located 5 miles southeast of Charleston, on the north side of Kanawha river, is possibly the oldest town in the Kanawha Valley. It has long been a mining and salt manufacturing town, and was a thriving village during the early history of the salt industry. The town is not incorporated, but has ten stores, four churches and one school. Malden also has a salt furnace, which will be discussed in a subsequent chapter.

Hansford.

Hansford is situated on the south side of Kanawha river, 21 miles southeast of Charleston, being the site of the Sheltering Arms Hospital. This institution was organized in January 1886 by Bishop Peterkin, Archdeacon Spurr and others of the P. E. Church, and has been maintained for the purpose of healing the sick and injured of the Kanawha and New River districts, special reference being had to the mining population and to the men employed on the railroad. For this purpose suitable property was secured at Paint Creek (now Hansford), on the C. & O. Railway, in the heart of the mining region, about twenty miles east of Charleston. This property was purchased at a cost of $2.500, and included about 13 acres of land and several small buildings. Through the efforts of Bishop Peterkin and others, more funds were secured, and in 1888 additional buildings were erected, and the hospital opened in the Fall of that year, having a capacity of about twenty patients. During the Summer and Fall of 1891 additional funds were raised and spent in further improvements, the capacity of the institution being increased to about thirty patients.

"The people were at first somewhat slow to avail themselves of the privileges offered, but soon about 600 names were enrolled on the list at the nominal rate of ten cents a month, the rate being increased in 1907, to fifteen cents a month. Up to the summer of 1890 the hospital had about 27 patients, a number that had increased to 116 by the year 1893-94. In 1907-08 the hospital cared for nearly 800 patients. Durings these years additions were made to the building and heating and electric light plants installed at a cost of about $10,000. A neat chapel and a home (costing about $4,500) to serve as the headquarters of a missionary, etc., were also erected on the grounds, and up to the summer of 1907 the whole property had increased in value to somewhere near $25,000. In the meantime a kind friend in New Jersey, the late Mrs. Chas. S. Olden, of Princeton, left a legacy amounting to $17,160. The institution also benefitted by $1,000 from the estate of Mrs. Waters, of Charleston, and by an anonymous gift of $5,000 from some one in Virginia. The increase from these legacies with the Thanksgiving-Day offering of the church throughout the diocese, ranging from $500 to $1,000, supplemented by boxes of supplies from branches of the Woman's Auxiliary and other friends all added to the regular income from the dues of the miners, which ranges from $10,000 to $12,000, enables the management to carry on the work successfully, the income from pay patients being comparatively small. To the original institution a Training School for Nurses is now added, from which several are graduated each year.

"The present neat and commodious building was opened July 15, 1908, at which time Bishop Peterkin delivered an interesting address, among other speakers being President Stevens, of the C. & O. R. R. and Archdeacon Spurr. The occasion was a notable one and many distinguished guests were present. The hospital now has accommodations for more than 100 patients, with an average of 60 patients a day, and 1,200 patients are treated annually. It receives patients with acute, curable, and non-contagious diseases, without distinction of creed, nationality or color. Patients not able to pay receive free treatment. There are a limited number of beds in wards for pay patients, and also a department for pay patients in private rooms. Visitors are admitted daily between 2 and 5 P. M."

The following are the officers and directors of this institution, as given in its twenty-first annual report, from which the facts herein given are quoted:

Board of Directors.

Rt. Rev. Geo. W. Peterkin, D.D., LL.D., President, Parkersburg.
Rt. Rev. W. L. Gravatt, D.D., Charles Town
Capt. W. R. Johnson, Vice-President, Crescent.
Rev. R. D. Roller, D.D., Chaplain and Secretary, Charleston.
D. T. Evans, Powellton.
C. A. Cabell, Carbon.
Archdeacon B. M. Spurr, Moundsville.
C. C. Beury, Claremont.
E. W. Grice, Hinton.

Executive Committee.

Rev. R. D. Roller, D.D., Charleston.
C. A. Cabell, Carbon.
D. T. Evans, Powellton.

Treasurer.

C. A. Cabell, Carbon.

Business Manager.

Ben R. Roller, Hansford.

Staff.

Superintendent—J. Ross Hunter, M.D.
Resident Physician—S. H. Yokeley, M.D.
Superintendent of Nurses—Miss Mary J. Parry, R. N.
Head Nurse—Miss Amy C. Dunlap, R. N.

Dunbar.

Dunbar is located on the north side of the Kanawha river, 6 miles west of Charleston, being connected with Charleston by an electric railroad. It was laid out by Hon. Fred P. Grosscup of Charleston in 1912, and has an art glass manufacturing plant which employs about 40 men. Its population in 1912 was 200, and it is not incorporated.

Dickinson.

Dickinson is located on the north side of Kanawha river, 14 miles east of Charleston. The town was named in honor of Mr. J. Q. Dickinson of Charleston, who operates the mines at this place. It is not incorporated but has a population of about 300.

Blue Creek.

Blue Creek is located on the south bank of Elk river, 13 miles northeast of Charleston, in the center of the Blue Creek oil field. Its population is about 100, having three stores, one school, and one church.

Sissonville.

Sissonville is located on Pocatalico river, 16 miles north of Charleston, and is the most northern village in Kanawha county. The town was named after John Sisson, who first owned the land on which the town is built, and it has a population of about 75, with four stores, one church, and one school.

The following is a list of towns and cross road villages other than those already described in Kanawha county, ranging in population from 50 to 1000, but as they are not incorporated their populations are not given in the report of the U. S. Census for 1910.

	Population		Population.
Dana	400	Winifrede	1500
Putney	900	Coalburg	450
Ward	1000	Kayford	1000
Mammoth	1200	Eskdale	400
Decota	300	Carbon	1200
Spring Hill	200	Quick	225
Bream	150	Blakely	350
Sproul	10	Dungriff	400
Olcott	600	Brounland	100
Hernshaw	850	Sattes	80
Lock Seven	200	London	600
Hugheston	500	Guthrie	25
Wallace	20	Blundon	60
Hunt	150	Welford	100
Weir	150	Queen Shoals	300
Morris	50	Dry Branch	250
Ronda	400	Mucklow	300
Sharon	300	Crown Hill	500
Burnwell	500	Chelyan	700
Cabin Creek Junction	100	South Ruffner	100
Kanawha	400	Washington Springs	70
Leon	55	Chilton	40
Monarch	300		

The figures given on the preceding pages are only approximate, as the majority of the places are mining towns and the population is very fluctuating, owing to labor conditions in the coal trade.

INDIAN MOUNDS.

Numerous artificial mounds are located on the second terrace of the Kanawha Valley just west of Charleston. Interesting investigations and examinations were made of some of these mounds in 1856-57 by Profs. Thomas and Norris of the Smithsonian Institute of Washington, D. C. The result of their work is published in the Fifth Annual Report of that Institute on pages 51-58 as follows:

"A large mound situated on the farm of Col. H. B. Smith, near Charleston, is conical in form, about 175 feet in diameter at the base and 35 feet high. It appears to be double; that is to say, it consists of two mounds, one built on the other, the lower or original one 20 feet and the upper 15 feet high.

"The exploration was made by sinking a shaft, 12 feet square at the top and narrowing gradually to 6 feet square at the bottom, down through the center of the structure to the original surface of the ground and a short distance below it. After removing a slight covering of earth, an irregular mass of large, rough, flat sandstones, evidently brought from the bluffs half a mile distant, was encountered. Some of these sandstones were a good load for two ordinary men.

"The removal of a wagon load or so of these stones stones brought to light a stone vault 7 feet long and 4 feet deep, in the bottom of which was found a large and much decayed human skeleton, but wanting the head, which the most careful examination failed to discover. A single rough spear head was the only accompanying article found in this vault. At the depth of 6 feet, in earth similar to that around the base of the mound, was found a second skeleton, also much decayed, of an adult of ordinary size. At 9 feet a third skeleton was encountered, in a mass of loose, dry earth, surrounded by the remains of a bark coffin. This was in a much better state of preservation than the other two. The skull, which was preserved, is of the compressed or 'flat-head' type.

"For some 3 or 4 feet below this the earth was found to be mixed with ashes. At this depth in his downward progress Colonel Norris began to encounter the remains of what further excavations showed to have been a timber vault, about 12 feet square and 7 or 8 feet high. From the condition in which the remains of the cover were found, he concludes that this must have been roof-shaped, and, having become decayed, was crushed in by the weight of the addition made to the mound. Some of the walnut timbers of this vault were as much as 12 inches in diameter.

"In this vault were found five skeletons, one lying prostrate on the floor at the depth of 19 feet from the top of the mound and four

others, which, from the positions in which they were found were supposed to have been placed standing in the four corners. The first of these was discovered at the depth of 14 feet, amid a commingled mass of earth and decaying bark and timbers, nearly erect, leaning against the wall, and surrounded by the remains of a bark coffin. All the bones except those of the left forearm were too far decayed to be saved; these were preserved by two heavy copper bracelets which yet surrounded them.

"The skeleton found lying in the middle of the floor of the vault was of unusually large size, 'measuring 7 feet 6 inches in length and 19 inches between the shoulder sockets.' It had also been inclosed in a wrapping or coffin of bark, remain of which were still distinctly visible. It lay upon the back, head east, legs together, and arms by the sides. There were six heavy bracelets on each wrist; four others were found under the head, which, together with a spear-point of black flint, were incased in a mass of mortar-like substance, which had evidently been wrapped in some textile fabric. On the breast was a copper gorget. In each hand were three spear-heads of black flint, and others were about the head, knees and feet. Near the right hand were two hematite celts, and on the shoulder were three large and thick plates of mica. About the shoulders, waist, and thighs were numerous minute perforated shells and shell beads.

"While filling in the excavation, the pipe represented in Fig. 4 was found in the dirt which had been removed from it. This pipe has been carved out of gray steatite and highly polished. It is worthy of note that it is precisely of the form described by Adair as made by the Cherokees, and also that it approaches very near to an Ohio type.

"Another mound of rather large size, in the same locality was opened by the Bureau assistant.

"In order that all the facts bearing on its uses may be understood it is necessary to notice its immediate surroundings.

"Plate V is a map showing the ancient works in the valley of the Kanawha, from 3 to 5 miles below Charleston, and Plate VI is an enlarged plat of the area embracing those numbered I, II and 1, 3, and 4 on the map. As will be seen by an inspection of the latter plate, the works included are two circular enclosures, 1 and 2; one excavation; one included mound, 2; three mounds, 3, 1, and 4, outside of the enclosures; and a graded way. As our attention at present is directed only to the large mound, 1, it is unnecessary to notice the other works further than to add that each enclosure is about 220 feet in diameter, and consists of a circular wall and an inside ditch. The excavation is nearly circular and about 140 feet in diameter. The large mound is conical in form, 173 feet in diameter, and 33 feet high. It is slightly truncated, the top having been leveled off some forty years ago for the purpose of building a judge's stand in connection with a race-course that was laid out around the mound.

"A shaft 12 feet square at the top and narrowing downward was sunk to the base. At the depth of 4 feet, in a very hard bed of earth and ashes mixed, were found two much decayed human skeletons, both stretched horizontally on their backs, heads south, and near their heads several stone implements. From this point until a depth of 24 feet was reached the shaft passed through very hard earth of a light gray color, apparently clay and ashes mixed, in which nothing of consequence was found. When a depth of 24 feet was reached

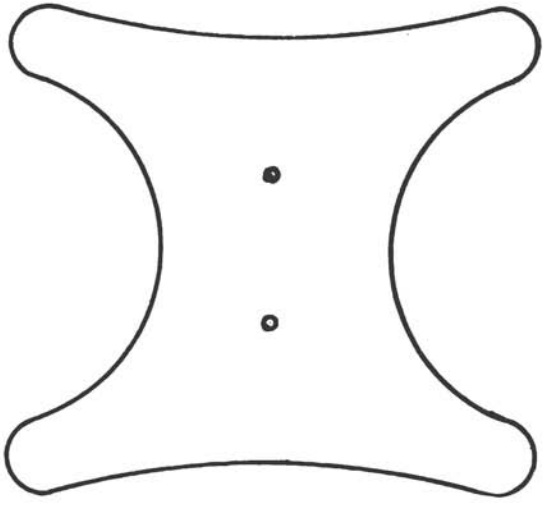


Fig. 3—Copper Gorget from Mound, Kanawha County.

Fig. 4—Pipe from Mound, Kanawha County.

Fig. 5—Pipe from Mound, Butler County, Ohio.

the material suddenly changed to a much softer and darker earth, disclosing the casts and some decayed fragments of timbers from 6 to 12 inches in diameter. Here were found fragments of bark, ashes, and also numerous fragments of animal bones, some of which had been split lengthwise. At the depth of 31 feet, was a human skeleton, lying prostrate, head north, which had evidently been enclosed in a coffin or wrapping of elm bark. In contact with the head was a thin sheet of hammered native copper. By enlarging the base of the shaft until a space of some 16 feet in diameter was opened, the character and the contents of the base of the mound were more fully ascertained. This brought to light the fact that the builders, after having first smoothed, leveled, and packed the natural surface, carefully spread upon the floor a layer of bark (chiefly elm), the inner side up, and upon this a layer of fine white ashes, clear of charcoal, to the depth, probably, of 5 or 6 inches, though pressed now to little more than 1 inch. On this the bodies were laid and presumably covered with bark.

"The enlargement of the shaft also brought to view ten other skeletons, all apparently adults, five on one side and five on the other side of the central skeleton, and, like it, extended horizontally, with their feet pointing toward the central one but not quite touching it. Like the first, they had all been buried in bark coffins or wrappings. With each skeleton on the east side was a fine, apparently unused lance-head about 3 inches long, and by the right side of the northern one a fish-dart, three arrow-heads, and some fragments of Unio shells and pottery. No implements or ornaments were found with either of the five skeletons on the west side, although careful search was made therefor. In addition to the copper plate, a few shell beads and a large lance-head were found with the central skeleton. As there were a number of holes resembling post-holes about the base, which was filled with rotten bark and decayed vegetable matter, I am inclined to believe there was a vault here similar to the lower vault in the Grave Creek mound, in which the walls were of timbers set up endwise in the ground. But it is proper to state that the assistant who opened the mound is rather disposed to doubt the correctness of this explanation.

"In order to show the character of the smaller burial mounds of this region, I give descriptions of a few opened by Colonel Norris.

"One 20 feet in diameter and 7 feet high, with a beech tree 30 inches in diameter growing on it, was opened by running a broad trench through it. The material of which it was composed was yellow clay evidently from an excavation in the hillside near it. Stretched horizontally on the natural surface of the ground, faces up and heads south, were seven skeletons, six adults and one child, all charred. They were covered several inches thick with ashes, charcoal, and fire-brands, evidently the remains of a very heavy fire which must have been smothered before it was fully burned out. Three coarse lance-heads were found among the bones of the adults, and around the neck of the child three copper heads, apparently of hammered native copped.

"Another mound, 50 feet in diameter and 5 feet high, standing guard, as it were, at the entrance of an inclosure, was opened revealing the following particulars: The top was strewn with fragmenents of flat rock, most of which were marked with one or more small, artificial, cup-shaped depressions. Below these, to the depth of 2 or 3 feet, the hard yellow clay was mixed throughout with sim-

FIG. 6

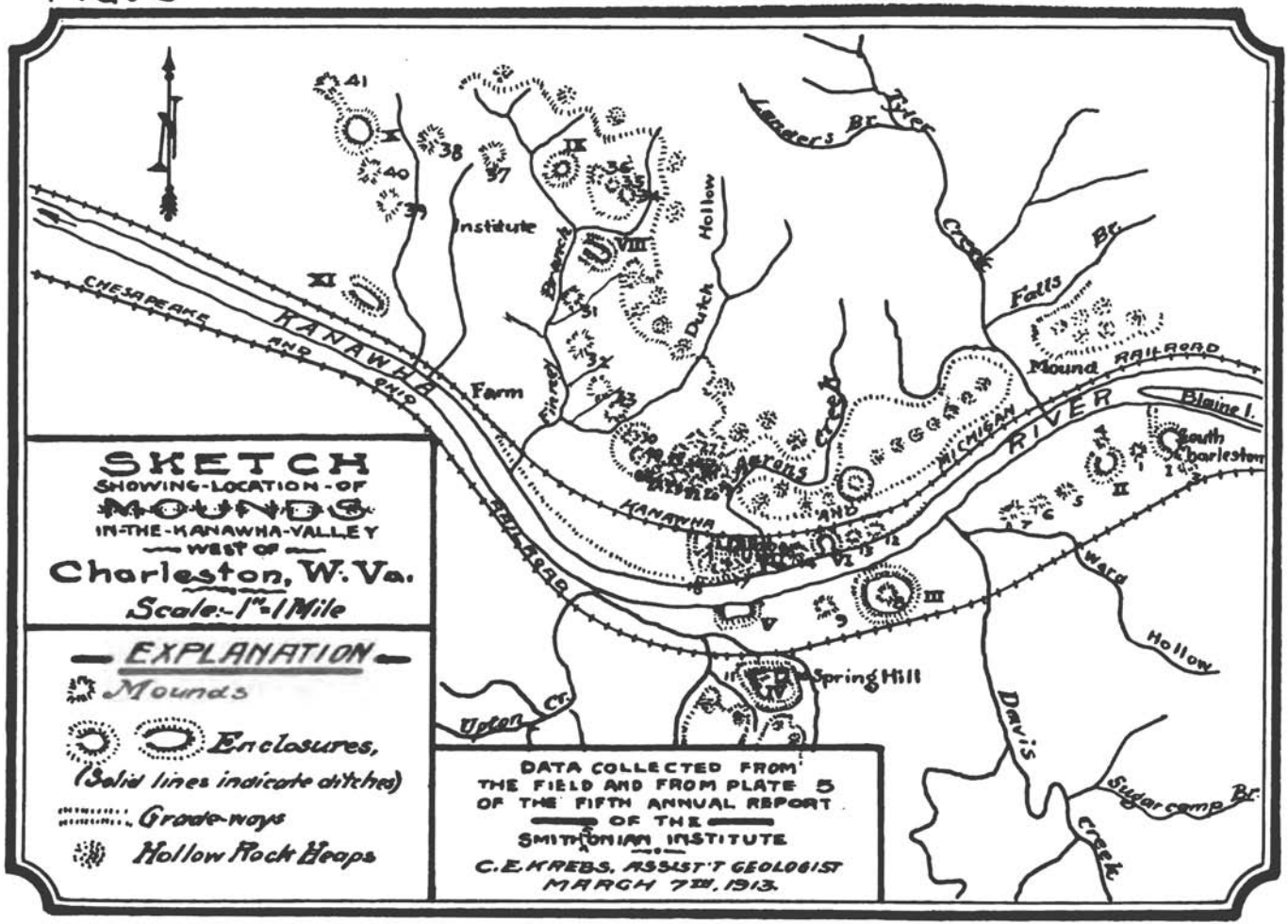


Fig. 6—Sketch Showing Location of Mounds in the Kanawha Valley.

ilar stones, charcoal, ashes, stone chips, and fragments of rude pottery. Near the center and 3 feet from the top of the mound were the much decayed remains of a human skeleton, lying on its back, in a very rude stone-slab coffin. Beneath this were other flat stones, and under them charcoal, ashes, and baked earth, covering the decayed bones of some three or four skeletons which lay upon the original surface of the ground. So far as could be ascertained, the skeletons in this mound lay with their heads toward the east. No relics of any kind worthy of notice were found with them.

"Another mound of similar size, upon a dry terrace, was found to consist chiefly of very hard clay, scattered through which were stone chips and fragments of rude pottery. Near the natural surface of the ground a layer of ashes and charcoal was encountered, in which were found the remains of at least two skeletons.

"A mound some 200 yards south of the inclosure, situated on a slope and measuring 50 feet in diameter and 6 feet in heighth, gave a somewhat different result. It consisted wholly of very hard clay down to the natural surface of the hill-slope. But further excavation revealed a vault or pit in the original earth 8 feet long, 3 feet wide, and 3 feet deep at the upper end. In this was found a decayed skeleton, with the head up hill or toward the north. Upon the breast was a sandstone gorget, and upon it a leaf-shaped knife of black flint and a neatly polished hematite celt. The bones of the right arm were found stretched out at right angles to the body, along a line of ashes. Upon the bones of the open hand were three piles (five in each) of small leaf-shaped flint knives.

"As the four small mounds just mentioned pertain to the Clifton groups, in the Elk River Valley, we will call attention to one or two of the Charleston group, for the purpose of affording the reader the means of comparison.

"Below the center of No. 7 (see plate), sunk into the original earth, was a vault about 8 feet long, 3 feet wide, and 3 feet deep. Lying extended on the back in the bottom of this, amid the rotten fragments of a bark coffin, was a decayed human skeleton, fully 7 feet long, with head west. No evidence of fire was to be seen, nor were any stone implements discovered, but lying in a circle just above the hips were fifty circular pieces of white perforated shell, each about 1 inch in diameter and an eighth of an inch thick. The bones of the left arm lay by the side of the body, but those of the right arm, as in one of the mounds heretofore mentioned, were stretched at right angles of the body, reaching out to a small oven-shaped vault, the mortar or cement roof of which was still unbroken. The capacity of this small circular vault was probably two bushels, and the peculiar appearance of the dark-colored deposit therein, and other indications, led to the belief that it had been filled with corn (maize) in the ear. The absence of weapons would indicate that the individual buried here was not a warrior, though a person of some importance.

"Mound No. 23 of this group presents some peculiarities worthy of notice. It is 312 feet in circumference at the base and 25 feet high, covered with a second growth of timber, some of the stumps of the former growth yet remaining. It is unusually sharp and symmetrical. From the top down the material was found to be a light-gray and apparently mixed earth, so hard as to require the vigorous use of the pick to penetrate it. At the depth of 15 feet the explorers began to find the casts and fragments of poles or round timbers

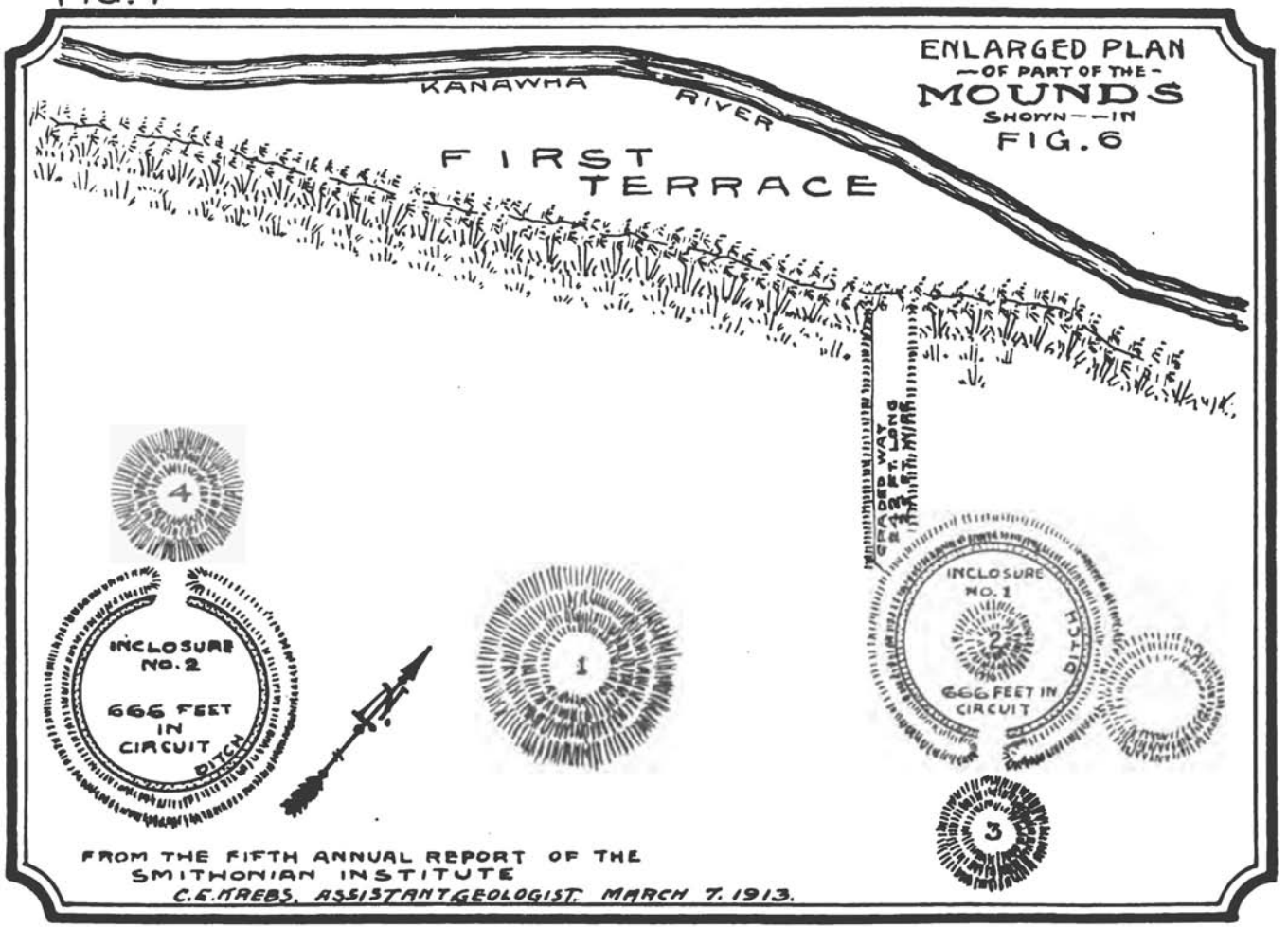


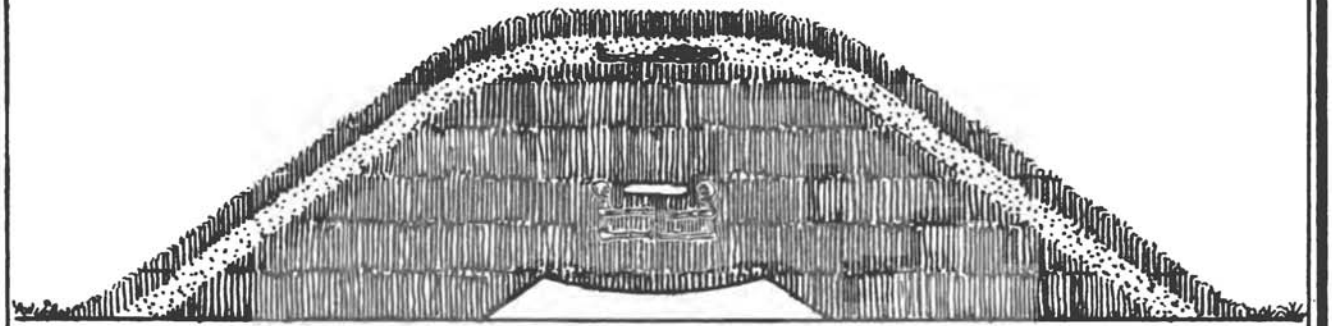
Fig. 7—Enlarged Plan of Part of the Mounds Shown in Fig. 6.

less than a foot in diameter. There casts and rotten remains of wood and bark increased in abundance from this point until the original surface of the ground was reached. By enlarging the lower end of the shaft to 14 feet in diameter is was ascertained that this rotten wood and bark were the remains of what had once been a circular or polygonal, timbered, and conical-roofed vault. Many of the timbers of the sides and roof, being considerably longer than necessary, had been allowed to extend beyond the points of support often 8 or 10 feet, those on the sides beyond the crossing and those of the roof downward beyond the wall. Upon the floor and amid the remains of the timbers were numerous human bones and also two skeletons, the latter but slightly decayed, though badly crushed by the weight pressing on them, but unaccompanied by an ornament or an implement of any kind. A further excavation of about 4 feet below the floor, or what was supposed to be the floor, of this vault, and below the original surface of the ground, brought to light six circular, oven-shaped vaults, each about 3 feet in diameter and the same in depth. As these six were so placed as to form a semi-circle, it is presumed there are others under that portion of the mound not reached by the excavation. All were filled with dry, dark dust or decayed substances, supposed to be the remains of Indian corn in the ear, as it was similar to that heretofore mentioned. In the center of the circle indicated by the position of these minor vaults, and the supposed center of the base of the mound (the shaft not being exactly central), and about 2 feet below the floor of the main vault, and in a fine mortar or cement, were found two cavities resembling in form the bottom or gourd shaped vessel so frequently met with in the mounds of southeastern Missouri and northeastern Arkansas. Unfortunately the further investigation of this work was stopped at this stage of progress by cold weather.

"In another mound in this group the burial was in a box-shaped stone vault, not of slabs in the usual method, but built up of rough, angular stones.

"Mound 31 of this group seems to furnish a connecting link between the West Virginia and Ohio mounds. It is sharp in outline, has a steep slope, and is flattened on the top; is 318 feet in circumference at the base and about 25 feet high. It was opened by digging a shaft 10 feet in diameter from the center of the top to the base. After passing through the top layer of surface soil, some 2 feet thick, a layer of clay and ashes 1 foot thick was encountered. Here, near the center of the shaft, were two skeletons, lying horizontally, one immediately over the other, the upper and larger one with the face down and the lower one with face up. There were no indications of fire about them. Immediately over the heads were one celt and three lance-heads. At the depth of 13 feet and a little north of the center of the mound were two very large skeletons, in a sitting posture, with their extended legs interlocked to the knees. Their arms were extended and their hands slightly elevated, as if together holding up a sandstone mortar which was between their faces. This stone is somewhat hemispherical, about 2 feet in diameter across the top, which is hollowed in the shape of a shallow basin or mortar. It had been subjected to the action of fire until burned to a bright red. The cavity was filled with white ashes, containing small fragments of bones burned to cinders. Immediately over this, and of sufficient size to cover it, was a slab of bluish-gray limestone about 3 inches thick, which had small cup-shaped excavations on the under side. This

FIG. 8



MOUND
With so-called
'ALTAR"

KANAWHA COUNTY
WEST VIRGINIA

FROM THE FIFTH ANNUAL REPORT OF THE
SMITHONIAN INSTITUTE
C. E. KREBS, ASSISTANT GEOLOGIST. MARCH 7TH 1913.

Fig. 8—Mound with so-called "Altar."

bore no marks of fire. Near the hands of the eastern skeleton were a small hematite celt and a lance-head, and upon the left wrist of the other two copper bracelets. At the depth of 25 feet, and on the natural surface, was found what in an Ohio mound would have been designated an 'Altar.' This was not thoroughly traced throughout, but was about 12 feet long and over 8 feet wide, of the form shown in Plate 6.

"It consisted of a layer of well-prepared mortar, apparently clay, slightly mixed with ashes. This was not more than 6 or 8 inches thick in the center of the basin-shaped depression, where it was about 1 foot lower than at the other margin. It was burned to a brick red and covered with a compact layer of very fine white ashes, scattered thickly, through which were small water-worn bowlders, bearing evidence of having undergone an intense heat. Mingled with this mass were a few thoroughly charred human bones. The material of the shaft, after the first 3 feet at the top, consists almost wholly of finely packed ashes, which appeared to have been deposited at intervals of considerable length and not at one time.

"It is evident from this description, which is abridged from the report of the assistant, that we have a true representation of the so-called 'altars' of the Ohio mounds. But, contrary to the usual custom, as shown by an examination of the Ohio works, this mound appears to have been used by the people who erected it as a burial place, for the mode of construction and the material used for the body of it forbid the supposition that the lower burial was by a different people from those who formed the clay structure at the base.'

A small mound occurs on the south side of the Kanawha river between Charleston and Malden. A small mound is also found on Cabin creek just north of Quarrier. It is 50 feet in diameter and 15 feet high and has large trees growing on same.

HISTORY OF TRANSPORTATION.

Water Ways.

Kanawha River.—The Kanawha river and its tributaries in the area under discussion were early used in transporting salt, coal, timber and logs. The salt and coal were taken into southern markets, while the logs were floated to accessible mills along their banks.

Locks and dams have been constructed by the U. S. government in the Kanawha river from Point Pleasant to Montgomery, making a seven-foot pool, thus affording navigation practically the whole year. Steam-boats ply between Point Pleasant and Montgomery, carrying passengers and freight, and also considerable coal is being transported in barges to southern markets.

Elk River.—This stream, a tributary of the Kanawha river, was early used for transporting timber to market, by floating large rafts of logs and cross ties to Charleston. Large canoes were formerly used for carrying the freight and supplies up and down the river; but since the construction of the Coal and Coke railroad, the canoe freight route is replaced by the freight train.

Coal River.—Coal river, a tributary of the Kanawha, was formerly used to float logs to Saint Albans, where large piers were built and dams placed across the stream to stop the logs from floating into the Kanawha river. This stream was also used in the early part of the nineteenth century for transporting cannel coal from the mines at Peytona. Since the construction of the Coal River railroad this method of transportation has been abandoned.

Steam Railroads.

The Chesapeake and Ohio Railway.—The history of this road is interesting. The enterprise had its origin in the charter of a company by the legislature of Virginia, February 18, 1836, to build a branch from the Richmond, Fredericksburg & Potomac Railroad through the county of Louisa, Virginia, and was called the Louisa Railroad. The road was built under this charter from Doswell (formerly Hanover Junction) on the Richmond, Fredericksburg & Potomac Railroad, 28 miles from Richmond to Louisa Courthouse, 34.7 miles and was operated by the Richmond, Fredericksburg & Potomac Co. Later it was extended in short sections at various times under several acts of the legislature to Jackson river, ten miles east of Covington, Va., on the west, and to the City of Richmond on the east, and was operated between these points in the spring of 1861. However, in 1850 its name was changed to "Virginia Central Railroad Company."

The Covington & Ohio Railroad, from Covington, Va., to the Ohio river, was authorized by the State of Virginia in 1853; and about $3,000,000 had been expended at the outbreak of the Civil War.

In 1868, the Virginia Central and the Covington & Ohio Railroad Company were united under the name of "Chesa-

peake & Ohio Railroad Company" and through the efforts of the late C. P. Huntington, the road was completed to Huntington, W. Va., in 1873.

In 1878 the road was sold under foreclosure and reorganized as the Chesapeake & Ohio Railway Company.

In 1882 the road was extended from Richmond to Newport News and Fortress Monroe, and in 1880 it was extended to Lexington, Ky., and Cincinnati, Ohio, and in 1908 by acquirement of a railroad in Indiana it was extended to Chicago by way of Indianapolis.

The road-bed is double tracked from Clifton Forge, Va., to Cincinnati, Ohio, with the exception of a few short stretches in tunnels and the gorge of New River from Cotton Hill to Gauley Junction, in Fayette county. The main line extends a distance of 39 miles in Kanawha county, or from a point just west of Montgomery to a point west of Saint Albans.

A number of branch lines have been built penetrating timber and mineral regions. Among those included in the area under discussion are the following:

Coal River Branch, Cabin Creek Branch and Paint Creek Branch.

Coal River Branch.—This railroad leaves the main line of the Chesapeake & Ohio at Saint Albans and extends to Sproul where it branches; one branch extends up Big Coal river to Seth, the mouth of Laurel creek, and the other branch extends up Little Coal river to Clothier where it branches again, one branch extending up Laurel Fork of Spruce, and the other up Main Spruce Fork.

The road was first constructed by local capital; but in 1905 was absorbed by the Chesapeake & Ohio Railway Co. The road extends in Kanawha county, from Saint Albans to one mile west of the mouth of Bull creek, a distance of 22 miles. This branch is a great freight carrying road, being the outlet of the coals from the Coal River Coal Basin.

Cabin Creek Branch.—This road leaves the main line of the Chesapeake & Ohio Railway at Cabin Creek Junction, and extends up Cabin creek and tributaries, through the mountains to Seng creek, a branch of Coal river, and down Seng creek to Coal river and up Coal river and Clear fork of said river to

Colcord. It was first constructed by private capital in 1894, as far as Acme, but was absorbed by the Chesapeake & Ohio Railway in 1902, and extended later to the head of the different branches and to Coal river.

It is a freight carrying road and is the outlet for the Cabin Creek coal field, and a portion of the Coal River field. This branch, including its tributaries, extends more than 25 miles in Kanawha county.

Paint Creek Branch.—This railroad leaves the main line of the Chesapeake & Ohio Railway at Paint Creek Junction, and extends up Paint Creek to Kingston, crossing the Kanawha-Fayette county line about one mile south of Burnwell. It extends for a distance of 14 miles in Kanawha county. This road was built by the Charles Pratt Company in 1902, to market the coal on land owned by the said company. The road was leased to the Chesapeake & Ohio Railway Company in 1904, and is operated by said company. It is a great freight carrying road for marketing coal from the Paint Creek field.

The Kanawha & Michigan Railway.—This road extends from Corning, Ohio, to Gauley Bridge, W. Va., entering West Virginia at Point Pleasant, where the railroad crosses the Ohio river. It extends along the north bank of the Kanawha, a distance of 42 miles in Kanawha county, from a point one mile south of Lock Seven to a point just west of Smithers. This railroad was completed to Charleston in 1892 and to Gauley Bridge in 1894.

The Kanawha & West Virginia Railroad.—The Kanawha and West Virginia Railroad connects with the Kanawha & Michigan Railway at Charleston, and extends up the north bank of Elk river, 13½ miles to the mouth of Blue creek, and thence crossing Elk river winds up Blue creek to Blakely, a total distance of 33½ miles. It is an important coal and timber road, and it has been projected to Curtin on the Richwood Branch of the B. & O. Ry. It was completed to Blakely in 1907.

Coal & Coke Railway.—This railroad was first built from Charleston to Clendenin, on the south side of Elk river, by local capital under the name of the Charleston, Clendenin & Sutton Railroad in 1890. In 1896 it was extended to Clay, and

in 1902 to Otter. In 1906 it was purchased by H. G. Davis and his associates, and organized under its present name. The old line was practically rebuilt, in completing its extension to Elkins, 175 miles from Charleston. The railroad extends about 28 miles in Kanawha county, from Charleston to Porter.

Kanawha & Coal River Railroad.—The Kanawha & Coal River Railroad extends from Spring Hill up Davis creek to Chilton. It was constructed in 1888 and used only as a coal and timber road. The Black Band mines at Chilton, having been suspended in 1909, the railroad is practically abandoned at present. It extends about 11 miles in Kanawha county.

The Kanawha Central Railroad.—The Kanawha Central Railroad is a short coal railroad extending from Brounland on the Coal River division of the Chesapeake & Ohio Railway, to Dungriff, where the mines are located and it is used to transport freight and passengers to Brounland. Its length is about 5 miles.

The West Virginia Southern Railway.—The West Virginia Southern Railway is a short coal railroad running up Lens creek from Marmet to Hernshaw and is used to carry coal, freight and passengers. Its length is about 4 miles. It was constructed in 1894.

The Winifrede Railroad.—The Winifrede Railroad is a short railway running up Fields creek from Lewiston (Winifrede Junction) to Winifrede. Its total length is about 7 miles. It is used to carry coal, freight, and passengers. It was constructed about 30 years ago.

The Campbells Creek Railroad.—The Campbells Creek Railroad extends from Dana on the Kanawha & Michigan Railroad up Campbells creek to Putney, a distance of 12 miles. It is used for transporting coal, timber, and passengers. It was extended to Putney in 1902.

The Kelly Creek Railroad.—The Kelly Creek Railroad runs from Cedar Grove on the Kanawha & Michigan Railroad up on the north side of Kelly creek to Mammoth, a distance of about 7 miles. It was constructed in 1890 by Mr. C. C. Lewis et als. of Charleston, to transport coal and timber to the mouth of Kelly creek.

The Kelly Creek & Northwestern Railroad.—The Kelly

Creek and Northwestern Railroad extends on the south side of Kelly creek from Cedar Grove to Mammoth. This road was built in 1904 for the purpose of transporting coal to the K. & M. railroad and the Kanawha river. Its length is about 7 miles.

Electric Railroads.

In addition to the foregoing railroads on which steam is used as the motive power, there are two other railroads on which electricity is used for traction purposes. One of these is the Charleston Interurban Company, operating a street railway on the principal streets of the City of Charleston, crossing the Kanawha river one mile below the mouth of Elk river, and extending on the south side of Kanawha river to Saint Albans.

The other electric road is the Charleston-Dunbar Traction Company, extending from Charleston to Dunbar along the north bank of Kanwha river, a distance of six miles.

Highways.

The value of good roads was more appreciated in the early history of the Kanawha Valley than at the present time. This changed condition was gradually brought about by the exchange of the stage coach for the steam boats, railroads and trolley cars. However, new interest is being awakened by the advent of the automobile, and soon a great improvement will be marked in the public highways.

The James River & Kanawha Turnpike.—The James River and Kanawha turnpike was constructed from James river across the Alleghany Mountains by way of White Sulphur Springs and Lewisburg. From the latter point across Sewell Mountain to Ansted and thence along the top of the Nuttall sandstone to the north side of New River to Hawks Nest, thence following along the edge of Gauley Mountain to Gauley Bridge where it crosses the Gauley river and extends along the north side of the Kanawha river to Charleston. This turnpike was constructed from 1840 to 1850, and was a turn-

pike until 1875 at the completion of the Chesapeake and Ohio Railway, when it was abandoned as a toll road and is now used as a public road.

The Giles, Fayette & Kanawha Turnpike.—This road extends from Giles county, Va., through Mercer county into Raleigh by way of Beckley and into Fayette county at the head of Upper Loup creek, running by way of Oak Hill and Fayetteville, reaching the Kanawha river at Kanawha Falls and from thence extending on the south side of Kanawha river to Charleston.

The Charleston & Point Pleasant Turnpike.—The Charleston and Point Pleasant turnpike, following the east bank of the Kanawha river, between the above points, was built in 1838.

The Charleston and Ravenswood Turnpike.—The Charleston and Ravenswood turnpike, running from Charleston by way of Sissonsville, Kenna and Ripley to Ravenswood, was constructed in 1856 to 1861.

The Guyandotte and Charleston Turnpike.—The Guyandotte and Charleston turnpike extending from Charleston on the south side of Kanawha river by way of Saint Albans, through Teays Valley to Guyandotte on the Ohio river, was constructed in 1854.

CHAPTER II.

THE PHYSIOGRAPHY OF THE KANAWHA COUNTY AREA.

A general description of the physiography of any region is of interest to those who are engaged in a scientific study of Nature's works. The principles of Physiography are ably set forth by Prof. G. P. Grimsley in the Detailed Report on Ohio, Brooke and Hancock counties, pages 18 to 23, and these are quoted in full in the Jackson, Mason and Putnam County Report, pages 16 to 22 inclusive, to which the reader is referred.

The erosive life of a river or smaller stream is not measured so much from the duration of its existence as by the work of erosion it has accomplished and what yet remains to be done. The different stages of a stream's life history have been discussed in preceding volumes of the detailed county reports, to which the reader is referred, and will not be given here.

If an examination of the drainage system of the area under discussion is made it will be found that Kanawha county is drained entirely by the Kanawha river and its tributaries, and that the Kanawha river and its tributaries on the south have a northwest trend, while the tributaries on the north have a general southwestern trend, indicating that these emptied into the Kanawha river in the pre-glacial period, when the Kanawha flowed through Teays Valley to the present site of Ironton, and from thence northward to the Great Lakes.

The following table shows in a graphic manner not only the rate of fall per mile of the principal streams of the Kanawha county area, but their departure from a straight line course, and the ratio of the total distance between the points of the same, measured by the meanders of the stream, to the air line distance between the same points:

STREAMS	Feet Total Fall	Total Dis. Miles	Rate of Fall Per Mile Feet	Air Line Dis. Miles	Ratio T. D. to A.L.D.
Kanawha River, from Gauley Bridge to Kanawha Falls	25.0	2.0	12.5	1.6	1.2
Kanawha River, from Kanawha Falls to Montgomery	20.25	9.5	2.1	7.0	1.3
Kanawha River from Montgomery to Charleston	38.75	26.0	1.5	20.7	1.2
Kanawha River from Charleston to Lock No. 7	8.5	15.8	0.53	12.6	1.2
Kanawha River from Lock No. 7 to Point Pleasant	29.5	44.2	00.67	35.0	1.3
Kanawha River from Gauley Bridge to Point Pleasant	99.5	97.5	1.02	61.0	1.6
New River, source to mouth	2320.0	284.0	8.2	124.0	2.3
New River, source to Hawks Nest	132.0	7.5	17.6	5.3	1.4
New River, Hinton to Thurmond	305.0	39.0	7.8	22.5	1.7
New River, Radford to Hinton	370.0	105.0	3.6	50.0	2.1
New River, source to Radford	1280.0	115.0	11.1	63.0	1.8
Greenbrier River, source to mouth	1390.0	140.0	9.9	87.0	1.6
Greenbrier River, Alderson to mouth	170.0	30.0	5.7	143.0	2.1
Greenbrier River, Ronceverte to Alderson	114.0	18.0	6.5	10.0	1.8
Greenbrier River, source to Ronceverte	1096.0	92.0	11.90	67.0	1.4
Gauley River, source to mouth	2215.0	100.0	22.1	55.5	1.8
Gauley River, source to mouth of Meadow River	530.0	29.0	18.3	14.3	2.0
Gauley River, mouth of Meadow River to mouth of Gauley River	1685.0	71.0	23.7	42.0	1.7
Pocatalico River, Walton to mouth	170.0	75.0	2.3	35.5	2.1
Pocatalico River, from Roane-Kanawha county line to Kanawha-Putnam county line	70.0	34.0	2.1	14.5	2.4
Rocky Fork, Fry to mouth	75	6	12.5	4	1.5
Tupper creek, Wallace to mouth	85	7	12.1	4.3	1.6
Middle fork, source to mouth	415	16.7	24.8	10.2	1.6
Middle fork, Fletcher to mouth	115	14.7	7.8	8.4	1.7
Coal river, Jarrolds Valley to mouth	265	59	4.5	34.3	1.7
Coal river, Brounland to month	55	27.5	2	11.4	2.4
Davis creek from mouth of Polly hollow to mouth	237	12	19.7	7.4	1.6
Lens creek, source to mouth	645	8	80.6	6.2	1.3
Lens creek, Hernshaw to mouth	105	4	26.2	3	1.3
Fields creek, Winifrede to mouth	230	4.3	53.3	3.7	1.2
Slaughter creek, Dotson to mouth	260	4.3	60.5	3.4	1.3
Cabin creek, Dacota to Leewood	262	4.3	60.9	3.7	1.2
Cabin creek, Leewood to mouth of Long Bottom creek	176	6.5	27.1	5.1	1.3
Cabin creek, mouth of Long Bottom creek to mouth	114	6.2	18.4	4.3	1.4

STREAMS	Feet Total Fall	Total Dis. Miles	Rate of Fall Per Mile Feet	Air Line Dis. Miles	Ratio T. D. to A.L.D.
Paint creek, source to mouth	1550	39	39.7	28	1.4
Paint creek, Burnwell to mouth	236	13.4	19.1	11	1.2
Twomile creek, mouth of Right fork to mouth	60	4.3	14	35	1.2
Elk river, source to Addison	1250	34	36.8	15.3	2.2
Elk river, Addison to Gassaway	660	46	14.3	25	1.9
Elk river, Gassaway to Clay	132	41	3.2	22.5	1.8
Elk river, Clay to Porter	65	23	3.8	9.5	2.4
Elk river, Porter to mouth	42	28	1.5	23	1.3
Elk Twomile creek, Rutledge to mouth	120	5.1	23.5	3.8	1.3
Mill creek, Villa to mouth	190	4.8	39.5	3	1.6
Cooper creek, mouth of Fivemile creek to mouth	75	4	18.8	3.6	1.1
Little Sandy creek, Hunt P. O. to mouth	78	10.9	7.1	6.8	1.6
Little Sandy creek, mouth of Frail branch to Hunt	58	5.2	11.2	4.3	1.2
Blue creek, Kanawha-Clay county line to Morris	170	8.2	20.7	6	1.4
Blue creek, Morris to Coco	58	7.7	7.5	3.8	2
Blue creek, Coco to mouth	70	6	11.7	3.8	1.6
Falling Rock creek, Kanawha-Clay county line to mouth of Evans fork	215	6	35.9	4.2	1.4
Falling Rock creek, mouth of Evans fork to mouth	185	8.5	21.7	5	1.7
Big Sandy creek, Newton to Osborne's Mill	90	16	5.5	7.8	2
Big Sandy creek, Osborne's Mill to mouth	90	9	2.2	4.2	2.1
Campbell creek Putney to Big Bottom	484	11	44	7	1.5
Campbell creek, Big Bottom to mouth	80	5	16	4	1.3
Witchers creek, source to Left fork	770	5.5	140	5	1.1
Witchers creek, mouth of Left fork to mouth	135	3.5	37.1	3	1.2
Kelly creek, Mammoth to Ward	80	1.5	53.3	1.3	1.1
Kelly creek, Ward to mouth	137	4.5	30.5	3.3	1.4
Hughes creek, mouth of Shadrick fork to mouth	240	4	60	3.3	1.2

In the last column of the foregoing table is given the ratio of the total distance (T.D.) measured by meanders of the streams to the air line distance (A.L.D.). In each instance it is very evident that the nearer this ratio approaches unity, the greater the rate of fall.

Fig. 9—Map and Profi

Data Concerning Locks and Dams in KANAWHA RIVER, W. VA.

(Furnished the Survey by Thos. E. Jeffers, U. S. Engineer, Charleston, W. Va.)

LOCKS

No. of Lock.	Miles from mouth.	1879 Low water.	Clear Width.	Available length.	Length over all.	Length between quoins	Tide reference. Miter sill.	Tide reference. Top of wall.
			Feet.	Feet.	Feet.	Feet.		
2.	84½	585.46	50	271	377	308	578.75	609.75
3.	79½	571.32	50	272	381	312	566.75	596.75
4.	73¼	564.44	50	274	365	300	559.75	579.75
5.	67¼	556.22	50	274	365	300	552.50	572.50
6.	54	548.64	55	313	410.5	342	543.75	565.50
7.	44	539.63	55	313	411	342	535.50	555.50
8.	36	531.27	55	313	411	342	526	547.25
9.	25¼	523.64	55	313	411	342	520.50	539.50
10.	19	517.41	55	313	411	342	514	533
11.	1¼	510.08	55	313	411	342	504	526

DAMS

No. of Lock.	Style.	Length of pass.	Length of Weir.	Height of pass trestle.	Length of wickets. Pass.	Length of wickets. Weir.	Tide reference. Pass sill.	Tide reference. Weir sill.	Tide reference. Upper pool.	Normal lift.	When finished.
		Feet	Feet	Ft. In.	Ft. In.	Ft. In.				Feet	
2.	Fixed	...	...	.. ...	.. ...	.. ...	.....	.....	597.75	10.33	1887
3.	"	...	...	.. ...	.. ...	.. ...	.....	.....	587.42	13.67	1882
4.	Movable	248	210	16 2¼	13 9	6 3½	561	567.75	573.75	7.25	1880
5.	"	250	265.5	17 ½	13 10	5 3	553.50	561.50	566.50	7.50	1880
6.	"	248	310	16 8½	13 5½	7 7	546.50	552	559	8.50	1886
7.	"	248	316	16 9¾	14 ⅛	9 2 5-32	537.50	542	550.50	8.25	1893
8.	"	248	292	16 9¾	14 ⅛	9 2 5-32	529.25	533.75	542.25	8	1893
9.	"	248	284	16 9⅝	14 ⅛	9 2 5-32	521.25	525.75	534.25	6.25	1898
10.	"	248	284	16 9¾	14 ⅛	9 2 5-32	515	519.50	528	7	1898
11.	"	304	364	16 9¾	14 ⅛	9 2 5-32	508	512.50	521	10.92	1898

NOTE: Upper miter sill: Lock No. 2=589.75; Lock No. 3=576.75. Top of wall at head of Lock No. 3=601.25.
Elevations are 3.855 Lower than U. S. Geological Survey.

Statement showing number of days that navigation was suspended on the Great Kanawha River on account of ice, from 1873 to 1912, as recorded in the office of Thomas E Jeffers, United States Engineer, Charleston, West Virginia.

1875	18	Days	1897	14	Days
1876	23	"	1898	13	"
1877	13	"	1899	20	"
1878	7	"	1900	23	"
1879	17	"	1901	4	"
1880	3	"	1902	21	"
1881	7	"	1903	8	"
1882	14	"	1904	65	"
1883	29	"	1905	4	"
1887	2	"	1906	4	"
1888	8	"	1907	12	"
1889	0	"	1908	7	"
1890	0	"	1909	0	"
1891	0	"	1910	16	"
1892	6	"	1911	15	"
1893	30	"	1912	44	"
1894	0	"			
1895	5	"	Total for 38 years	465	days.
1896	13	"	Average per year	12.3	days.

The following table shows the monthly rainfall at Charleston, W. Va., for 28 years, as measured by Thos. E. Jeffers, United States Engineer:

Rainfall at Charleston, West Virginia for 28 Years, 1885-1912. Inches.

	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.	Total
1885 ...	5.12	2.12	1.57	2.84	2.38	2.49	4.13	4.61	1.25	5.30	2.08	1.61	35.50
1886 ...	2.86	2.49	4.10	3.25	5.51	6.90	2.38	3.57	5.13	0.91	4.32	2.78	44.20
1887 ...	1.88	8.10	2.69	4.60	2.13	3.31	2.20	4.96	2.96	0.61	1.16	1.73	36.33
1888 ...	3.55	3.25	4.28	1.97	3.72	1.40	3.88	4.64	6.29	6.30	2.69	1.67	43.64
1889 ...	3.53	2.13	1.97	2.23	6.49	7.19	6.31	1.87	5.69	3.12	5.37	1.60	47.50
1890 ...	3.55	6.86	8.94	4.48	6.94	2.86	2.93	9.05	3.08	3.14	2.00	5.40	59.23
1891 ...	4.38	5.47	4.55	2.31	4.84	7.74	3.79	6.16	1.23	1.94	3.25	2.83	48.49
1892 ...	3.62	2.08	4.52	4.99	4.96	2.74	4.08	4.27	1.59	0.59	3.75	3.59	40.78
1893 ...	2.56	4.43	1.60	3.54	2.95	4.29	4.08	4.27	1.59	0.59	3.75	3.59	40.49
1894 ...	2.32	5.00	2.09	3.16	3.88	2.82	0.42	1.56	4.00	1.16	2.50	3.91	32.82
1895 ...	5.15	0.73	4.24	2.60	2.08	2.04	4.43	5.68	1.16	1.20	1.85	2.62	33.78
1896 ...	1.00	4.01	7.10	2.67	4.24	4.81	5.11	4.74	3.84	2.62	3.68	1.68	45.50
1897 ...	1.20	5.62	3.13	2.74	4.63	6.34	4.00	3.10	0.48	0.00	3.79	4.10	39.13
1898 ...	6.15	2.23	7.20	2.16	3.17	3.10	5.45	7.53	3.72	4.30	2.66	2.45	50.09
1899 ...	7.34	4.20	8.49	1.49	4.05	5.40	5.39	4.54	3.40	0.86	1.75	2.06	48.97
1900 ...	1.31	3.35	3.15	0.96	2.78	7.09	3.80	2.88	0.66	1.80	6.58	1.89	36.25
1901 ...	1.49	0.72	2.91	6.47	5.11	6.86	1.94	5.23	3.43	0.38	1.50	7.28	43.32
1902 ...	4.25	4.04	3.66	1.86	1.96	6.52	4.90	1.30	3.04	1.74	3.56	5.69	42.52
1903 ...	1.82	7.99	4.10	5.46	1.84	3.48	2.52	1.44	0.28	1.70	2.16	2.19	34.98
1904 ...	2.19	2.63	3.54	4.08	2.72	2.69	3.28	3.45	1.51	1.65	0.45	2.65	30.84
1905 ...	3.28	2.94	4.81	3.33	5.69	5.05	4.56	3.82	1.06	5.31	2.17	2.96	44.98
1906 ...	3.31	1.65	5.37	1.96	2.25	5.76	5.59	2.51	3.62	1.60	1.97	4.77	40.36
1907 ...	5.02	4.31	3.72	3.59	3.66	6.27	5.31	7.12	2.59	3.10	3.91	2.37	50.97
1908 ...	2.16	3.71	7.10	7.15	4.50	2.50	4.25	1.94	0.40	1.24	1.53	3.29	39.77
1909 ...	2.74	4.04	4.98	4.88	4.42	5.88	5.60	3.66	4.10	1.83	2.39	1.27	45.79
1910 ...	5.05	3.09	0.66	3.37	4.93	8.61	5.18	0.78	4.88	1.62	2.13	3.06	44.36
1911 ...	5.32	2.51	3.62	4.53	1.37	3.13	1.84	7.45	3.15	5.15	3.94	3.25	45.26
1912 ...	2.56	3.03	5.52	4.28	2.76	3.09	6.15	5.49	2.11	2.70	1.36	2.91	40.26
Average	3.38	3.67	4.27	3.46	3.78	4.66	4.05	4.20	2.13	2.16	2.79	3.04	42.33

A regular record of the gauge of the Kanawha river was established at Charleston July 1st, 1873, under the direction of Col. E. Munice, Corps of Engineers United States Army, by A. M. Scott, Assistant Engineer.

The gauge reading is the available water in the channel at the shallowest places below Charleston, particular reference being made to the foot of Elk River Shoals.

Zero reading of the gauge equals 554.496 feet War Department Levels or 558.351 feet United States Geological Survey Levels.

Maximum and Minimum River Stages at Charleston.

The following data on Maximum and Minimum river stages at Charleston have been copied from the records in the

office of Thos. E. Jeffers, United States Engineer at Charleston. These records for a period of 40 years show the highest stage of the river during this time to be 41.10 feet in February 1897. Prior to this period the highest rise was 46.87 feet in September 1861. The lowest stage reached during the 40 years was in October, 1885.

Maximum River Stages, Charleston, W. Va., July, 1873, to Dec. 31, 1912.

	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.
1873	....	....	....	....	....	....	5.1	5.8	4.4	6.6	14.9	10.1
1874	16.3	10.0	11.3	31.6	13.9	4.1	12.0	7.9	5.6	9.4	8.8	10.7
1875	8.6	32.5	20.7	19.4	10.7	9.0	23.3	31.3	5.5	5.4	11.5	13.0
1876	14.7	15.3	14.9	13.0	9.5	13.1	7.2	13.0	20.0	5.9	10.5	5.7
1877	33.3	6.7	13.0	12.4	12.8	6.4	6.0	3.4	4.9	7.5	34.3	9.5
1878	19.8	17.1	16.0	11.3	15.0	6.8	10.9	16.3	39.2	6.7	21.1	24.9
1879	36.7	17.1	11.1	8.4	7.9	6.2	3.2	5.8	3.7	6.4	3.5	18.7
1880	6.1	26.3	21.2	23.8	15.8	13.8	4.3	4.8	7.1	4.2	6.1	12.9
1881	19.0	18.2	8.9	12.3	6.3	6.7	4.6	2.4	11.6	2.3	7.3	16.0
1882	24.4	20.8	18.5	8.5	18.8	8.6	10.8	9.5	16.2	5.4	4.4	8.5
1883	18.2	25.9	25.4	25.7	6.1	7.6	6.1	2.8	6.3	6.0	6.8	17.9
1884	13.9	28.4	25.8	10.1	8.0	13.9	8.0	5.6	2.5	0.7	3.8	8.8
1885	17.4	9.7	8.3	12.1	12.8	11.2	4.9	4.2	1.5	12.8	12.4	14.3
1886	28.0	14.5	22.0	38.8	22.3	12.7	12.3	5.9	4.1	5.0	12.8	12.3
1887	20.0	23.7	14.5	22.7	14.4	8.4	5.0	5.5	4.9	6.0	4.8	5.0
1888	7.4	13.2	15.0	9.5	8.1	8.4	6.6	5.1	16.4	18.6	11.9	10.9
1889	17.7	22.3	8.9	8.4	19.2	28.5	14.4	13.2	12.0	12.0	14.1	7.7
1890	11.6	26.0	31.0	14.4	17.6	5.9	3.5	6.4	5.7	13.1	6.8	7.8
1891	26.9	24.1	22.0	19.0	12.0	14.1	5.0	8.0	5.3	2.7	7.7	11.5
1892	28.8	8.0	16.0	26.3	12.7	7.9	4.4	4.4	4.3	2.2	5.1	8.2
1893	11.3	11.2	9.8	12.2	27.0	8.2	5.1	3.3	11.4	11.6	5.8	6.5
1894	7.0	19.9	10.0	6.4	6.9	5.5	3.4	2.9	2.1	2.2	3.4	7.2
1895	18.4	6.0	18.3	23.9	9.9	4.8	7.3	3.6	3.6	1.1	2.9	6.2
1896	8.5	12.0	24.5	23.5	9.2	9.2	18.9	8.0	3.2	10.8	14.1	11.4
1897	6.2	41.1	14.2	9.1	20.6	12.5	14.6	5.0	2.2	4.4	3.1	8.4
1898	13.1	6.5	19.4	17.2	14.7	6.6	9.8	31.0	9.0	20.0	11.3	8.5
1899	24.6	19.4	40.2	10.0	16.4	10.0	7.9	7.4	4.9	2.7	7.2	9.8
1900	11.0	16.0	20.5	8.5	7.0	10.0	7.4	5.4	3.6	17.8	30.9	17.2
1901	17.0	8.4	12.0	25.8	35.9	21.0	8.3	15.7	7.0	6.5	....	35.1
1902	20.8	21.6	33.0	14.0	10.4	8.3	7.6	7.0	7.0	7.1	7.5	12.1
1903	17.7	24.0	24.0	12.9	9.3	8.1	7.0	7.7	7.2	7.0	7.0	6.6
1904	9.4	8.0	11.4	14.3	9.6	7.8	7.4	7.3	6.8	6.9	7.2	7.3
1905	11.7	7.6	25.3	8.6	27.5	7.5	20.2	7.8	7.4	11.2	7.3	10.6
1906	27.6	7.6	11.6	13.0	7.9	7.8	7.4	11.2	9.0	19.8	22.5	17.2
1907	29.3	10.5	20.9	13.8	7.9	31.3	8.4	13.4	12.0	8.5	12.3	14.4
1908	21.9	27.0	18.2	29.9	13.0	7.5	9.0	9.5	9.1	7.4	7.1	7.7
1909	11.8	11.2	12.0	12.9	15.8	8.9	11.2	7.4	7.7	7.8	7.8	7.9
1910	13.4	12.8	10.3	9.0	9.3	21.1	8.9	7.3	7.7	7.8	7.7	7.6
1911	26.2	18.2	10.7	16.0	7.6	7.4	7.7	7.4	7.9	8.4	8.7	10.2
1912	8.0	16.1	15.5	13.0	15.5	9.0	8.7	8.0	9.0	7.9	8.8	8.3

Minimum River Stages at Charleston, W. Va., from July, 1873, to December 31, 1912.

	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct.	Nov	Dec.
1873	....	....	....	....	....	....	2.9	2.9	2.0	1.9	3.1	3.5
1874	3.4	5.4	4.6	6.3	3.6	2.3	1.9	2.4	1.3	2.3	2.0	4.5
1875	4.2	4.5	7.7	6.2	3.6	3.5	5.9	4.1	2.3	2.9	2.8	5.4
1876	4.2	6.1	5.0	5.5	5.1	3.3	2.9	3.2	3.5	2.8	2.7	4.3
1877	2.8	3.8	3.5	6.5	4.4	3.8	3.7	1.9	1.6	1.8	2.9	4.7
1878	4.3	6.2	5.5	5.6	6.0	4.4	3.4	4.3	3.1	3.0	5.2	5.4
1879	3.5	5.8	6.1	5.0	3.8	2.2	1.5	2.9	1.4	1.1	1.9	3.2
1880	4.3	4.0	6.3	4.9	3.3	3.1	2.7	1.9	1.3	1.6	2.4	2.9
1881	2.0	6.0	6.0	6.1	2.6	2.2	1.2	0.1	0.4	0.7	2.8	4.4
1882	5.8	6.5	6.1	4.5	5.8	4.1	2.8	2.3	4.0	2.7	2.5	2.6
1883	3.7	6.2	5.5	7.8	4.0	3.2	2.1	0.5	0.4	2.3	2.8	3.8
1884	3.8	6.6	8.0	5.5	5.4	3.5	2.5	1.9	1.0	0.3	0.7	1.5
1885	4.7	4.3	4.2	4.8	3.6	3.4	3.0	1.6	0.1	0.1	4.6	4.9
1886	4.5	4.8	4.8	4.4	6.0	5.0	3.6	3.1	1.9	1.9	4.8	4.0
1887	5.4	7.5	4.9	4.9	4.4	4.0	4.3	4.7	4.5	4.5	4.5	4.0
1888	3.3	4.4	5.0	4.5	4.2	4.0	3.6	4.4	4.2	5.0	4.8	4.5
1889	6.4	4.8	5.2	4.5	4.5	5.0	5.0	4.4	4.9	3.8	5.7	4.7
1890	5.8	7.9	6.3	6.5	6.1	3.2	2.0	2.4	2.4	4.6	4.3	3.6
1891	6.3	8.3	7.2	5.0	3.8	3.7	3.6	2.9	2.2	2.0	2.0	2.9
1892	5.0	4.6	5.8	5.9	5.0	3.7	2.8	1.7	1.3	1.4	1.4	2.8
1893	2.5	6.0	4.5	5.0	4.9	3.6	2.0	1.2	3.0	2.9	2.8	3.4
1894	4.9	5.1	4.9	3.9	3.1	2.2	1.4	1.0	0.1	1.0	2.1	2.1
1895	2.7	1.0	6.4	4.7	4.7	1.9	1.8	2.2	1.1	0.9	1.0	1.8
1896	1.0	3.9	4.6	4.5	3.0	2.5	2.6	2.4	2.1	1.9	2.9	3.2
1897	2.9	3.5	6.2	4.3	3.5	3.6	3.1	2.0	0.7	0.6	1.3	1.8
1898	4.1	3.0	3.8	5.2	3.8	1.4	1.7	3.3	1.2	1.2	4.8	3.8
1899	5.5	4.9	7.1	5.0	3.0	3.9	3.6	1.9	1.9	1.6	3.2	2.4
1900	0.9	2.0	5.7	4.7	4.6	4.5	4.0	1.8	1.5	5.1	7.6	4.8
1901	4.6	3.5	5.1	6.3	5.2	6.0	4.5	5.0	4.7	4.2	....	4.1
1902	4.1	4.2	5.6	5.2	5.1	5.0	5.6	6.4	5.0	5.3	6.1	4.0
1903	5.0	6.5	5.7	6.8	4.1	4.6	4.8	6.5	6.5	6.6	6.5	0.1
1904	2.5	3.9	5.6	4.8	4.8	4.8	4.8	6.5	6.3	6.1	6.8	7.0
1905	1.5	1.7	6.6	5.8	4.4	4.9	4.7	7.1	6.8	6.8	7.0	4.9
1906	4.9	3.9	5.1	5.1	4.4	6.2	6.3	5.9	4.6	4.6	5.1	4.8
1907	5.2	5.2	4.8	6.4	5.3	5.0	5.4	4.0	5.2	4.3	4.4	5.1
1908	5.8	4.5	6.2	6.0	5.8	4.4	6.4	4.4	5.8	4.2	4.1	5.9
1909	5.3	3.8	5.3	5.1	5.3	5.4	4.6	6.8	6.8	6.8	6.8	1.8
1910	1.6	4.8	5.3	6.5	5.2	5.3	5.1	6.6	5.0	6.9	6.9	2.9
1911	5.4	5.0	5.8	6.6	5.0	5.9	6.5	6.5	6.4	5.1	5.3	7.0
1912	3.0	4.2	5.3	5.7	6.6	5.1	6.5	6.8	6.9	6.8	6.3	2.8

NOTE.—When the minimum reading is less than 4.5, it indicates the wickets at Lock No. 6 are down.

The following table gives the average gauge reading at Charleston, W. Va., for each month and for each year from July 1, 1873, to Dec. 31, 1912, as copied from the records in the United States Engineers Office of Charleston, West Virginia.

Average Gauge Reading of Kanawha River Each Month from July 1, 1873, to December 1, 1912, taken at Charleston, W. Va., by the U. S. Engineers.

YEAR	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1873	.....	.....	.....	.....	.....	.....	4.27	3.96	2.90	3.16	5.51	6.19
1874	7.81	6.34	6.38	13.67	5.62	3.28	3.71	4.19	2.44	3.82	3.56	6.50
1875	6.27	8.24	10.60	8.50	5.69	5.91	10.57	9.11	3.34	3.63	6.61	7.22
1876	7.26	7.95	7.95	7.35	6.85	5.20	4.28	5.47	8.44	3.63	4.05	4.61
1877	11.54	4.71	7.04	7.82	7.23	4.94	4.26	2.38	2.49	3.60	7.69	5.88
1878	8.91	8.79	7.73	7.14	8.83	5.52	4.63	6.73	7.59	3.97	7.71	9.30
1879	11.38	7.71	8.13	6.27	5.48	3.62	2.43	3.54	2.28	2.35	2.47	7.41
1880	5.32	7.94	10.58	7.69	5.53	4.96	3.36	3.04	3.21	2.25	4.11	5.99
1881	7.64	9.36	7.27	8.09	4.28	3.88	2.34	1.19	2.14	1.35	4.49	7.36
1882	12.29	11.55	8.75	6.24	8.50	5.78	5.52	4.67	6.54	3.29	8.12	5.14
1883	7.62	11.27	7.06	12.07	4.88	5.05	3.75	1.72	1.98	3.77	6.61	6.08
1884	7.29	16.91	11.87	7.37	6.07	5.41	4.56	3.16	1.29	0.47	1.27	4.19
1885	6.80	5.47	6.38	7 07	6.02	5.01	3.33	3.08	00.91	2.49	6.03	6.22
1886	8.13	7.65	7.69	12.61	8.78	6.85	6.91	4.36	2.60	4.11	5.95	6.54
1887	7.50	11.89	7.55	8.40	6.62	5.41	4.70	4.79	4.63	4.79	4.69	4.71
1888	5.59	7.75	7.14	5.94	5.96	5.17	4.77	4.11	6.82	8.14	6.52	5.97
1889	7.94	7.49	6.22	5.51	6.51	8.98	6.99	6.31	5.83	5.59	8.32	5.74
1890	7.14	11.38	11.59	8.79	8.26	4.02	2.80	3.66	3.93	6.19	4.85	5.32
1891	9.79	13.42	10.93	10.26	4.79	6.67	3.89	4.43	3.36	2.35	3.65	5.69
1892	8.67	5.87	8.61	9.60	6.67	5.92	3.17	2.49	2.06	1.59	2.90	4.04
1893	4.18	10.32	6.30	6.45	8.75	5.37	3.09	2.32	4.58	6.04	4.31	4.54
1894	5.06	7.67	6.84	5.12	4.97	3.26	2.20	2.02	1.21	1.37	2.52	3.80
1895	8.09	3.42	9.11	7.97	5.87	2.89	3.69	3.08	2.17	1.02	1.75	3.20
1896	4.03	6.70	8.10	7.79	5.03	4.45	6.59	4.36	2.35	4.61	5.22	6.13
1897	4.57	2.47	9.14	6.15	6.93	5.39	6.44	3.09	1.44	1.63	1.88	4.64
1898	7.02	5.24	7.27	7.60	6.64	3.37	3.88	7.53	3.98	5.30	6.78	5.85
1899	8.42	9.81	13.58	6.37	6.92	6.68	4.96	4.17	3.03	2.05	4.44	5.20
1900	4.69	6.97	9.52	6.14	5.63	5.86	5.27	3.32	2.19	9.45	14.10	7.65
1901	6.91	5.39	7.14	13.74	10.93	10.23	6.33	7.72	5.76	5.25	.....	14.04
1902	7.89	8.27	11.78	7.80	6.39	5.63	6.73	6.69	6.37	6.42	6.70	6.69
1903	7.08	10.20	10.99	9.24	5.94	6.73	6.78	6.90	6.79	6.67	6.85	3.28
1904	3.94	4.85	7.01	6.32	6.69	6.65	6.95	6.89	6.59	6.92	7.02	7.22
1905	5.28	4.60	8.42	6.29	8.65	6.97	7.65	7.42	7.38	7.40	7.29	6.69
1906	8.33	5.68	8.45	7.61	6.42	7.29	6.76	6.80	6.71	7.12	7.34	7.49
1907	10.51	6.27	9.29	8.57	6.54	9.42	6.52	7.12	7.09	6.11	7.61	7.44
1908	7.90	8.74	10.09	10.50	7.76	6.58	7.14	7.14	6.65	6.84	6.67	7.04
1909	7.15	7.89	7.76	7.45	7.64	7.23	7.18	6.86	7.06	6.89	6.92	4.86
1910	6.98	7.33	6.88	7.54	7.52	8.93	7.02	6.93	7.02	7.12	7.19	5.72
1911	9.29	7.88	7.99	9.05	6.64	6.91	6.95	6.92	7.10	7.66	7.42	7.69
1912	5.41	6.66	10.90	8.42	8.01	7.17	7.14	7.29	7.18	7.12	7.06	6.74

Average Gauge Reading of Kanawha River for Each Year from July 1, 1873, to December 1, 1912, taken at Charleston, W. Va., by the U. S. Engineers.

Years		Years	
1873	6.70	1893	5.52
1874	6.61	1894	3.84
1875	7.14	1895	4.35
1876	6.09	1896	5.44
1877	5.79	1897	5.31
1878	7.24	1898	5.87
1879	5.25	1899	6.30
1880	5.33	1900	6.56
1881	4.95	1901	8.49
1882	6.77	1902	7.28
1883	5.98	1903	7.29
1884	5.82	1904	6.42
1885	4.90	1905	7.00
1886	6.85	1906	7.16
1887	6.30	1907	7.70
1888	6.15	1908	7.75
1889	6.78	1909	7.07
1890	6.49	1910	7.18
1891	6.60	1911	7.62
1892	5.08	1912	7.43

In Kanawha county, the principal southern tributaries of the Kanawha river are Coal river, Davis, Lens, Fields, Slaughter, Cabin and Paint creeks. Its northern branches are Two-mile creek, Elk river, Campbell, Witchers, Kelly and Hughes creeks.

A description of these tributaries will now be given:

Coal River.

Coal river is formed by the junction of Clear and Marsh Forks at Jarrolds Valley on the Boone-Raleigh county line, and flows in a northwestern direction for 59 miles, emptying into the Kanawha river at Saint Albans. It flows 31.5 miles through Boone county, 3.2 miles as a dividing line between Boone and Kanawha counties, then 6 miles through Kanawha county, then 4 miles as a dividing line between Lincoln counties, and 14.3 miles through Kanawha county before emptying into the Kanawha river.

Its fall from Jarrolds Valley to Saint Albans is 265 feet or 4.5 feet per mile. It falls 38 feet from Brounland to Saint

Albans in a distance of 17.5 miles or 2.2 feet to the mile. Its drainage area in Kanawha county is 68.4 square miles. Its entire length measured by the meanders is 59 miles, while the air line distance between its source and its mouth is but 34.3 miles. Passing up the river, the first 12 miles has a very crooked course and has almost reached base level. It is very probable that it once left its present course about 0.5 miles above Lower Falls P. O. and flowed across a low divide southwest to Saint Albans, reaching Saint Albans at the same point in 1.4 miles instead of 5.5 miles measured by its present course.

Coal river was locked and dammed in 1840-1860 by the Coal River Navigation Company under Captain (later General) Rosecrans, for the purpose of transporting cannel coal from Peytona to the market. During the Civil War these improvements were neglected and the river washed them out.

Davis Creek.

Davis creek rises just north of the corner of Washington and Loudon district in the Kanawha-Boone county line, 2.3 miles west of Hernshaw and flows in a general northwestern direction, emptying into the Kanawha river about one mile northwest of Spring Hill. Its entire length measured by the meanders of the stream is 15 miles. The air line distance from source to mouth is 10 miles. Its drainage area is 45.6 square miles. From the source of Davis creek to the mouth of Polly hollow, about one mile below Chilton, a distance of 3 miles, it falls 520 feet or about 173.3 feet to the mile. From the latter point to the mouth of Sugar Camp branch, the fall is 120 feet in 4 miles, or at the rate of 30 feet to the mile. From the latter point to the mouth of Middle Fork of Davis creek, the fall is 85 feet in 5 miles or at the rate of about 17 feet to the mile. From the mouth of Middle Fork to its mouth, the fall is 30 feet in 3 miles or at the rate of 10 feet to the mile.

Lens Creek.

Lens creek has its source in a high ridge dividing Kanawha and Boone counties, at the corner of Sherman and Peytona districts, Boone county, 4 miles southwest of Hernshaw,

Kanawha county, and 3.5 miles northeast of Racine, Boone county, and almost in a direct line drawn from Hernshaw to Racine, and it flows in a northeastern direction, emptying into the Kanawha river about 0.5 miles above Marmet. The length of Lens creek from source to mouth by the meanderings of the stream is 8 miles and the airline distance between the same points is 6.2 miles. Its drainage area is 19.6 square miles. Its fall from source to mouth is 645 feet. The fall from its source to Hernshaw is 540 feet in 4 miles, or at the rate of 135 feet per mile. From Hernshaw to its mouth the fall is 105 feet in 4 miles, or at the rate of 26.2 feet per mile.

Fields Creek.

Fields creek empties into the Kanawha river at Winifrede Junction. It rises in the high ridge dividing Kanawha and Boone counties, 2.3 miles due south from Winifrede. It drains an area of 13 square miles. The length of Fields creek, measured by the meanderings, is 7.2 miles. Its air line distance between the same points is 5.8 miles. Its fall from source to mouth is 950 feet. From Winifrede to mouth it falls 230 feet in 4.3 miles, or at the rate of 53.3 feet to the mile.

Slaughter Creek.

Slaughter creek heads up against Joes creek of Coal river in the Boone-Kanawha county line, 4.3 miles southeast of Winifrede and flows a little east of north, emptying into the Kanawha river at Chelyan. Its entire length by the meanders is 7 miles, while the air line distance between the same points is 6 miles. Its drainage area is 15 square miles. From Dotson fork to Bradley fork, the fall is 95 feet in 1.2 mile, or about 80 feet to the mile. From the latter point to the Kanawha river the fall is 165 feet in 3.1 miles, or at the rate of 53.2 feet to the mile, practically the same as Fields creek.

Cabin Creek.

Cabin creek rises in the southwestern part of Fayette county almost 3.5 miles southwest from Keeferton and flows

in a northern direction, emptying into Kanawha river at Cabin Creek Junction.

It flows 2 miles through Fayette county, and 21 miles through Kanawha county, crossing the Kanawha-Fayette county line at 0.4 mile east of Republic. Its entire length measured by the meanders of the creek is 23 miles, and the air line distance between the same points is 18 miles. Its drainage area in Kanawha county is 65 square miles. From Republic to Decota, the creek falls 420 feet in 3.2 miles, or at the rate of 131.2 feet per mile. From the latter point to Leewood the fall is 262 feet in 4.3 miles, or at the rate of 61.2 feet to the mile. From Leewood to the mouth of Longbottom creek, the fall is 176 feet in 6.5 miles, or at the rate of 27.1 feet to the mile. From the latter point to the mouth of the creek, the fall is 114 feet in 6.2 miles, or at the rate of 18.4 feet to the mile.

Paint Creek.

Paint creek has its source in Raleigh county just north of Harper, and flows in a general northern direction to the Kanawha river at Paint Creek Junction or Pratt P. O. Paint Creek is 39 miles in length from source to mouth by the meanders. The creek flows 6.5 miles through Raleigh, crossing the Fayette-Raleigh county line at 0.2 mile north of Cirtsville. It flows 17.5 miles through Fayette county, crossing the Fayette-Kanawha county line about one mile southwest from Burnwell, and flows 15 miles through Kanawha county. The drainage area of Paint creek in Kanawha county is 35 square miles. From its source to its mouth Paint creek falls 1550 feet in 39 miles, or at the rate of 39.7 feet to the mile. From Burnwell to its mouth the fall is 256 feet in 13.4 miles or at the rate of 19.1 feet per mile.

Pocatalico River.

The Pocatalico river takes its source on the Arches Fork anticline about 4 miles southwest from Linden P. O., Smithfield district, Roane county, and flows in a meandering course just a little south of west, emptying into the Kanawha river

at Raymond City. Its entire length, following the meanders is 75 miles, thirty miles of this length being in Roane county, 34 miles in Kanawha, and eleven miles in Putnam county. After making a detailed study of the country surrounding the mouth of this river, it appears more than probable that it emptied into the Kanawha river at Scary when the latter flowed through Teays Valley. The probable former course left the present channel at Rocky Fork P. O. and flowed by way of the "Flatwoods", Fry P. O., Armour and Blake creeks to the Kanawha river. This old course was about 150 feet higher than the present one. This river enters Kanawha county one mile east of Island Branch P. O., and 2 miles just a little east of south from the common corner of Kanawha, Roane and Jackson counties and leaves it 0.8 mile northwest of Rocky Fork P. O. Its fall from where it enters Kanawha county to where it leaves the same is 70 feet, distance 34 miles, or about 2 feet per mile. Its course is very crooked. Its meandering course is 34 miles while its air line distance is but 14.5 miles. This stream is fast approaching base level. Its principal tributaries in Kanawha county are Rocky Fork, Tupper creek, and Middle Fork. A short description will be given of each.

Rocky Fork takes its source one mile north of the Kanawha river and 1.3 mile northwest of Institute and flows for two miles northwest to Fry P. O., thence for six miles northeast, emptying into Pocatalico river at Rocky Fork P. O. The entire drainage area is 19.2 miles. Its fall from source to mouth is 290 feet and its fall for the last six miles is but 75 feet, or 12.5 feet per mile.

Tupper Creek takes its source about one mile southwest of Wallace P. O. and flows in a northern direction into Pocatalico river about one mile southwest of Sissonville. The area drained by this stream is 24.2 square miles. Its length is 8 miles and its fall from its source to its mouth is 290 feet while its fall for the last 7 miles is but 85 feet, or less than 11 feet per mile.

Middle Fork takes its source near a common corner of Jackson and Roane county, 3.2 miles northeast from Kentuck, Washington district, Jackson county, and flows southwest 15.5 miles through Jackson, thence almost south 1.2 miles through

Kanawha, emptying into the Pocatalico river one mile due north from Sissonville. Its entire length following the meanders is 16.7 miles, while its air line distance is 10.2 miles. The area in Kanawha county drained by this stream is 13.4 miles. Its fall from its source to its mouth is 415 feet. In the last 14.7 miles it falls but 115 feet, while in the last four miles it has a fall of but 20 feet, or 5 feet per mile.

Kanawha Twomile Creek.

Twomile creek heads up against Wolfpen branch of Tupper creek, 1.5 mile southeast from Wallace P. O. and flows in a general southeastern direction, emptying into the Kanawha river at the upper end of Blaine Island, 2 miles below mouth of Elk river. The length of Twomile creek proper, from source to mouth, measured by the meanders, is 6.5 miles; the length of the creek, including the Right fork, is 9.5 miles. The air line distance from source to mouth of Twomile creek proper is 5.2 miles. The drainage area is 26 square miles. From the mouth of the Right Fork to its mouth, Twomile creek falls 60 feet in 4.3 miles, or at the rate of 14 feet to the mile.

Elk River.

Elk river has its birth in the junction of Old Field Fork and Big String Fork, just east of Sharp Knob in the northwestern part of Pocahontas county and flows in a general western direction, emptying into the Kanawha river at Charleston. The length of Elk river, from source to mouth, following its meanders, is 172 miles. It flows 5 miles through Pocahontas county, 7 miles through Randolph, 41 miles through Webster, 44 miles through Braxton, 45 miles through Clay and 30 miles through Kanawha county. From its source to Addison, Webster county, Elk river falls about 1250 feet in 34 miles, or the rate of about 37 feet to the mile. From Addison to Gassaway the fall is 660 feet in 46 miles, or the rate of 14.3 feet per mile. From Gassaway to Clay the fall is 132 feet in 41 miles, or at the rate of 3.2 feet to the mile. From Clay to Porter, the fall is 65 feet in 23

miles, or at the rate of 2.8 feet to the mile. From Porter to its mouth the fall is 42 feet in 28 miles, or at the rate of 1.5 feet per mile. Its drainage area in Kanawha county is 294 square miles.

The principal tributaries of Elk river in Kanawha county, ascending the river are: Elk, Twomile, Mill, Cooper, Little Sandy, Blue, Falling Rock and Big Sandy creeks. A brief description of each will now be given.

Elk Twomile Creek takes its source in the divide between Mill creek and Campbell creek, one mile southeast of Villa P. O., and flows in a western direction, emptying into Elk river about 2 miles above Charleston. The drainage area of Elk Twomile is 12 square miles. From Rutledge to the mouth of Baker fork the fall is 81 feet in 2.5 miles, or at the rate of 32.4 feet to the mile. From the latter point to its mouth, the fall is 39 feet in 2.6 miles, or at the rate of 17.3 feet to the mile. The length of Elk Twomile, from source to mouth, is 8 miles.

Mill Creek rises at the Malden-Elk district line, 3.5 miles east of Villa P. O., and flows in a western direction, emptying into Elk river at Milliken. The length of Mill creek by the meanders is 8.3 miles. The drainage area is 7.5 square miles. From Villa P. O. to the mouth, Mill creek falls 190 feet in 4.8 miles, or at the rate of 39.5 feet to the mile.

Cooper Creek heads at the Poca-Elk district line, 1 mile due west of Aaron P. O., and flows in a southern direction emptying into Elk river just below Big Chimney station on the K. & W. V. R. R. The entire length by its meanders is 6.7 miles. The fall from source to mouth is 545 feet. From the mouth of Fivemile Fork to the mouth of Cooper creek the fall is 75 feet in 4 miles, or 18.8 feet to the mile.

Little Sandy Creek takes its source in the southern part of Roane county and flows in a southwestern direction, emptying into Elk river 9.7 miles above Charleston. Its entire drainage area is 51.8 square miles, 46.5 of which lies in Kanawha county. It crosses the Kanawha-Roane county line 4.1 miles west of Cotton P. O. Its length, from source to mouth, by the crooks is 19.6 miles, the air line distance between the same points is 13 miles. From the mouth of Trail branch, one-half mile south of the Kanawha-Roane county line to Hunt P. O.,

the fall is 58 feet in 5.2 miles, or at the rate of 11.2 feet to the mile. From Hunt to the mouth the fall is 78 feet in 10.9 miles or 7.1 feet to the mile.

Its principal branches are **Aarons Fork** and **Wills Creek.**

Blue Creek rises in the eastern edge of Kanawha county and flows 0.5 mile northeast into Clay county, crossing the Kanawha-Clay county line 0.6 mile west of Bird Knob, Clay county, thence in a general northern direction 4.7 miles through Clay county, again crossing the Kanawha-Clay county line 1 mile southeast of Beulah Knob, thence in a western direction 8.2 miles to Morris P. O., thence in a northwestern direction, 13.7 miles, emptying into Elk river at Blue creek. Its entire length, by the meanders, is 27.1 miles and the air line distance is 14.8 miles. Its drainage area within Kanawha county is 90.2 square miles. From the mouth of Spruce Fork —just west of the Kanawha-Clay county line—to Morris, the fall is 170 feet in 8.2 miles, or at the rate of 20.7 feet to the mile. From Morris to Coco the fall is 58 feet in 7.7 miles, or at the rate of 7.5 feet to the mile. From Coco to the mouth at Blue Creek the fall is 70 feet in 6 miles, or at the rate of 11.7 feet to the mile.

The principal tributaries in succession, passing up the stream are **Morris, Middle** and **Spruce Forks.**

Falling Rock Creek heads in the Kanawha-Clay county line, 0.5 mile east of Beulah Knob, and flows 15.5 miles in a general northwestern direction, emptying into Elk river at Falling Rock. **Falling Rock creek** flows one mile north through Clay county, crossing the Kanawha-Clay county line, one mile northeast of Beulah Knob, thence 14.5 miles through Kanawha county. Its drainage area in Kanawha county is 24.5 square miles.

From the Glass Lick Branch, just west of the Kanawha-Clay county line to the mouth of Evans Fork the fall is 215 feet in 6 miles, or at the rate of 35.9 feet to the mile.

From the latter point to its mouth the fall is 185 feet in 8.5 miles, or at the rate of 21.7 feet to the mile.

Big Sandy Creek is formed by the Right and Left Forks of Big Sandy at Newton P. O., Roane county, and flows in a general southwestern direction, emptying into Elk

river at Clendenin. Its length from the junction of the Right and Left forks at Newton, to its mouth is 25 miles. The air line distance between the same points is 12 miles. Its drainage area within Kanawha county is 20.3 square miles, while its area is about 122 square miles.

From Newton to Osbornes Mills, just above the Roane-Kanawha county line, the fall is 90 feet in 16.0 miles, or at the rate of 5.5 feet to the mile. From Osbornes Mills to Clendenin, the fall is about 20 feet in 9.0 miles, or at the rate of 2.2 feet to the mile.

Campbell Creek.

Campbell creek has a drainage area of 47 square miles and empties into the Kanawha river one-half mile below Dana. It has its source near the common corner of Elk, Cabin Creek, and Malden districts, about one mile east of Putney and is 16 miles in length from source to mouth, the air line distance between the same points being 11 miles. From Putney to Big Bottom the fall is 484 feet in 11 miles, or at the rate of 44 feet to the mile. From Big Bottom to the mouth the fall is 80 feet in 5 miles, or at the rate of 16 feet to the mile.

Witchers Creek.

Witchers creek rises near the Cabin Creek-Malden district line, 2 miles southwest of Putney, and flows southwest into the Kanawha river, about one mile below Winifrede Junction. Its length from source to mouth is 9 miles, while its air line distance is 7.7 miles. Its drainage area is 21.5 square miles. From source to mouth of Left Fork, the fall is 770 feet in 5.5 miles, or at the rate of 140 feet to the mile. From the mouth of Left fork to the mouth of Witchers creek the fall is 135 feet in 3.5 miles, or at the rate of 37.1 feet to the mile.

Kelly Creek.

Kelly creek empties into the Kanawha river at Cedar Grove, having a drainage area of 25 square miles. It is formed at the junction of Goose Hollow and Hurricane Fork and flows

in a southwestern direction, its entire length by the meanders being 6 miles, while its air line distance between the same points is 5.2 miles. From Mammoth to Ward the fall is 80 feet in 1.5 miles, or 53.3 feet to the mile. From Ward to its mouth the fall is 137 feet in 4.5 miles, or 30.5 feet to the mile.

Hughes Creek.

Hughes creek drains about 12.7 square miles. It rises in the western part of Kanawha county and flows in a southwestern direction, emptying into the Kanawha river at Hugheston. It is 7.5 miles in length, following the meanders, while the air line distance between the same points is 6 miles. From the mouth of Shadrick fork to the mouth of Hughes creek the fall is 240 feet in 4 miles, or at the rate of 60 feet to the mile.

New River.

New River is formed by the confluence of North Fork and Three Top creek at Creston, Ash county, N. C., and flows in a northeastern direction 31 miles through North Carolina; then in a general eastern direction for 12 miles through Virginia; thence through North Carolina for 2 miles, crossing the North Carolina and Virginia state line 4 miles due south from Independence, Va. Thence it flows in a general northeastern direction through Virginia 100 miles to Peppers Ferry, where it veers to a general northwestern direction for 50 miles through Virginia to the Virginia-West Virginia State line, crossing the same 4 miles due west from Peterstown, West Virginia; thence in a general northwestern direction for 89 miles through West Virginia, to Gauley Bridge. Its entire length by the meanders is 284 miles, the air line distance between the same points is 124 miles. From its source to Radford, New River falls 1280 feet in 115 miles, or at the rate of 11.1 feet to the mile. From Radford to Hinton the fall is 370 feet in 105 miles, or at the rate of 3.6 feet to the mile. From Hinton to Thurmond the fall is 305 feet in 39 miles, or at the rate of 7.8 feet to the mile. From Thurmond to Hawks Nest the fall is 233 feet in 17.5 miles, or at the rate of 13.3 feet to the mile. From Hawks Nest to Gauley Bridge, or its mouth,

the fall is 132 feet in 7.5 miles, or at the rate of 17.6 feet to the mile.

Gauley River.

Gauley river has its source in the junction of the North, Middle and South Forks in the southeastern part of Webster county, 3 miles northwest of Buck Knob of Gauley mountain, and 6 miles due west of the source of Elk river, and flows in a general western direction, 31 miles through Webster county; then in a general southwestern direction 41 miles through Nicholas county; thence in a general western direction as the dividing line between Nicholas and Fayette counties for 25.5 miles; thence in a southern direction through Fayette county 5.5 miles to Gauley Bridge. The entire length by the meanders is 101 miles, the air line distance between the same points being 55.5 miles. From its source to the mouth of Meadow river, Gauley river falls 1685 feet in 73 miles, or at the rate of 23.4 feet to the mile. From the mouth of Meadow river to the mouth of Gauley it falls 530 feet in 29 miles, or at the rate of 18.3 feet to the mile.

Like all other counties in western West Virginia, the Kanawha county area is a highly dissected plateau, ranging in elevation from 1000 to 2400 feet above sea level. The agencies of erosion have reduced the plateau practically all to slope. The streams generally flow in narrow, deeply indented "v" shaped valleys. The numerous ridges and knobs capped with harder layers of rocky strata, ranging from 1000 to 2400 feet above tide, are witnesses of the existence of this former plateau.

The Kanawha river has cut a deep gorge from ½ to 1½ miles in width, and 400 to 1500 feet in depth, entirely through the length of the county, in a northwest direction, through almost horizontal rocks. Elk river has done likewise in a southwest direction, across a portion of the northern part of the county, the gorge being from ½ to 1 mile in width and from 400 to 1000 feet in depth; while Coal river, flowing north through the western part of the county, has cut a gorge ½ to ¾ mile in width, and from 400 to 800 feet in depth.

The valley walls, in most instances, are quite steep and rough, caused by the outcrop of the great sandstone ledges,

but over a portion of the northern part of the county, the outcropping shales of the Conemaugh series have weathered into a fairly uniform, gentle slope.

The flood plains of the Kanawha, Elk, and Coal rivers are represented by narrow strips of fertile bottom land along their shores, that widen first on one side and then on the other.

River Terraces.

Several pronounced terraces occur along the valley walls of the Kanawha, Elk and Coal rivers. The most persistent one along the Kanawha river occurs at an elevation of 680 to 720 feet A.T., about 140 to 170 feet above the low water level of the river. This terrace occurs at Saint Albans and east of Coal river, where a portion of the town is located.. It is readily traced on first one side of the river and then on the other all the way up the Kanawha to the Kanawha-Fayette county line, by deposits of chert bowlders and Black Flint blocks, having about the same tide level as the recent formations along Teays Valley made during the glacial period. At Spring Hill this terrace forms considerable level land; also at South Charleston it forms an extensive terrace on which the town of Vandalia is located.

At Marmet, Cabin Creek Junction and Pratt, on the south side of the Kanawha river, terraces formed during this period are very pronounced, occurring at about 700 to 750 feet above sea level.

This terrace is also pronounced on the south side at Charleston, where a large number of beautiful residences are located.

On the north side of the Kanawha river, from Lock Seven to mouth of Smithers creek, the terraces formed during the glacial period are very pronounced, and deposits of bowlders and blocks of Kanawha Black Flint occur on them.

At Institute, nine miles west of Charleston, these terraces are in evidence, about 150 to 175 feet above the level of the Kanawha river. Glenwood Heights and Edgewood, suburbs of the city west of Elk river, are located on this terrace at which level the river flowed in preglacial time, while on the east side of Elk river, Capitol Hill and the terrace where the

City hospital is located, are on this same level, where evidences of the old river deposits of silt, sand, and bowlders are seen at an elevation A.T. of 695 to 710 feet.

At Dana occurs a terrace elevated 650 feet A.T. where Campbell creek overflows into the Kanawha river, but was deflected and flows into the Kanawha about ½ mile west of this point. This terrace is narrow and the Campbell Creek Coal Company has cut through it in grading its railroad, extending same up Campbell creek.

These terraces occur similarly along Elk river. The divide between Elk Twomile and Coon Skin is broad and about the level of the Teays formation, or at an elevation of 680 to 710 feet A.T. Also between Twomile creek and Indian creek and between Indian creek and Pinch creek, and between Pinch and Blue creek, near its mouth. All these divides are low and broad and are covered with river deposits, including bowlders as large as 7 inches in diameter. These bowlders could have been deposited only by a stream flowing across the divides. A feature similar to those just described is seen opposite the mouth of Coonskin branch on the north side of Elk river, where the county road leaves Elk and crosses a low divide descending to Mink Shoal branch. The low divide through which the road passes, contains a deposit of rounded bowlders and sand, which evidently marks the position of an old stream channel.

The terraces along Coal River, about the same altitude as the rock floor of the Teays formation, are numerous and well pronounced. They are the remains of old broad valleys within which the river has cut its present narrow channel.

One of these channels is visible on the west of Coal river from a point about one mile south of Upper Falls, along the low divide through which the county road passes to a point one mile south of Lower Falls. This divide is low and broad and is covered with river deposits, including sand and bowlders, which could only have been deposited by a flowing stream.

A similar feature occurs west of Coal river, from a point one-half mile north of Upper Falls to the mouth of the river, where the county road passes. This divide is low and broad

and is covered with sand and pebbles. Several similar features also occur on the east side of Coal River, from Forks of Coal to its mouth.

Pocatalico River has a terrace about the same altitude as the rock floor of Teays Valley. The most important feature is the old river channel, where it left its present course at the mouth of Rocky Fork and flowed by way of Flatwoods, and Fry; thence along the course of Armour creek to Blake creek to the Kanawha river at a point near the present site of Scary. This course is marked with sand, gravel and bowlders.

PART II.

The Geology of Kanawha County.

CHAPTER III.

STRUCTURE

INTRODUCTION.

Geological Structure treats of the pitch or lay of the strata of the earth's surface. The original position of the rock beds, however formed, whether by lava flow or sedimentation, is horizontal or tangential to the curvature of the earth, at the point of contact. The original lay or attitude of these rocks, however, is much changed by lateral pressure produced by the contraction of the earth's interior, and the rocks composing the crust of the latter are bent and warped by this pressure into a number of approximately parallel wrinkles or folds. In Kanawha county these folds all have a distinct northeast-southwest trend. In the description of these folds the upward bending arch is called an **anticline** and the downward bending a **syncline.** The **axis** of any fold is the line joining the highest points of any anticline or the lowest points of any syncline, and from which the strata dip is an anticline and to which they dip in a syncline. The **strike** is the direction of the horizontal edge of dip beds and is frequently, although not always, parallel to the axis of a fold, diverging from when the axis is not horizontal. The sudden fall of the axis of an anticline forms what is called a **nose** of the fold. The original position of rock beds of any sedimentary formation is horizontal. These de-

posits, however, may take on a slope of considerable pitch. Earth movements cause modification of this original position and produce the above described structural forms generally used in geology.

METHOD OF REPRESENTING STRUCTURE.

There are two methods that can be used in representing gelogical structure. One of these is by cross sections at right angles to the strata, which show the rocks as they would appear if a deep canal or section were dug perpendicularly across the entire area under discussion. This method can be used where the dip of the rocks is very heavy and is perceptible to the eye, but in the Kanawha area it would not be practical nor satisfactory without greatly exaggerating the vertical scale of the cross section in comparison to the horizontal scale; also this method would only give an idea of the structure along certain lines and would not give the slope of the arches or basins. This is of great value in the commercial development of the area, for both future mining of the coal, and the exploitation of the oil and gas territory.

The method of representing the structure which has been adopted by the West Virginia Geological Survey, consists in the representation by contour lines of the position of some particular stratum. This stratum is generally the one that is known throughout the area by its exposures in the outcrop, its relation to some other bed above or below it, or its wide use as a key-rock by the drillers for oil and gas. These contour lines show in a general way the form and the size of the folds into which the key-stratum has been distorted and its altitude above the level of the sea at all points.

In the Kanawha County Area, the writer has taken bottom of the Pittsburgh-Pomeroy Sandstone or the top of the Pittsburgh coal bed as the key-rock for that part of country north of a line extending from the mouth of Little Coal river to the mouth of Elk river, and from thence with a straight line to the mouth of Queen Shoal creek, near the corner of Kanawha and Clay counties. South of these lines the writer has taken the base of the Kanawha Black Flint Ledge as the key-rock. This is a very widely known and

easily identified stratum, and is used as a key-rock by all coal prospectors in the Kanawha Valley.

The roof portion instead of the floor or bottom, of the Pittsburgh seam was taken by the writer as a datum under which to represent the geological structure for the reason that frequently the coal was not exposed, but the base of the overlaying sandstone could easily be located, and, moreover, the thickness of this seam of coal is quite variable in the area under discussion. The altitude of the Pittsburgh coal seam has been determined from its elevations at different points on the outcrop in the county; also from records of core drill holes and the well records drilled for oil and gas throughout the northern part of the area, by taking coals on the surface and then determining the altitude of the coal from these records. After the elevation of the Pittsburgh coal had been determined in many places, points of equal elevation are connected by contour lines. For illustration, all points having an elevation of 600 feet above mean tide are connected by a line which will then become the 600-foot contour line. In the same manner all points having an elevation of 575 feet are connected by 575-foot contour lines and so on. Contour lines as drawn show a vertical distance of 25 feet throughout the entire area. These lines are printed on the structural and economic map accompanying this report in a separate case, and show not only the approximate elevation of the top of the Pittsburgh coal above sea level, but both the horizontal contour of the troughs and arches and the depth of the beds. Note that the depth of the Pittsburgh coal or reference stratum at any point is obtained by subtracting its elevation from the elevation of the surface at the same point as shown by the topographic map.

The altitude of the Kanawha Black Flint Ledge has been determined from its elevation at the different points of its outcrop, also from records of core drill holes throughout the area, by taking coals on the surface and then determining altitude of the Flint from the records.

As a rule these structure contours are only approximately correct from the very nature of the data from which they are made, being estimated on the assumption that over small areas

the rocks maintain a uniform thickness, when it is a well known fact that in some places the interval between two easily determined strata will vary many feet in a short distance. It follows that the position of the contour will be in error the amount the increase or decrease in thickness varies from the calculated thickness.

Another cause of error is in the method of determining the elevation of the outcrop of the key stratum, or of the tops of the many oil and gas wells drilled down through the same. In many cases these altitudes were determined by spirit level, but the great majority were determined with the aneroid barometer. The aneroid was checked as frequently as possible on the spirit levels of the U. S. Geological Survey left at conspicuous points along the public highways in the preparation of their accurate topographic map of Kanawha county in cooperation with the State of West Virginia. In this way the instrumental error is kept down. The errors may accumulate, or may compensate one another, but in any case it is believed that their sum is less than one contour interval, that is less than 25 feet, and over much of the area of Kanawha the possible variation from actual altitude will not likely be more than 10 to 20 feet.

DETAILED GEOLOGIC STRUCTURE.

Kanawha county is situated on the eastern flank of the Great Appalachian **Geo-Syncline,** which enters West Virginia near the southwest corner of the State of Pennsylvania, and extends through the entire State, crossing the Kentucky line, about nine miles south of Kenova.

The following is a list of the most important **anticlines** and **synclines** in Kanawha county:

Anticlines.	**Synclines.**
Byrnside	Saint Albans
Milliken	Guthrie
Warfield	Jarrett
Winifrede	Coalburg
Hansford	Handley
Wake Forest	Quincy
	Robinson
	Miami

The slope and location of the above structural forms are all indicated on the map accompanying this report. A brief description will be given of these arches and troughs.

Byrnside Anticline.—The Byrnside anticline takes its name from a small town located just west of the crest of this fold in Putnam county. It originates in the northeastern corner of Lincoln county and passes almost due north across the Lincoln-Putnam county line just west of the common corner of Lincoln, Putnam and Kanawha counties; thence deflects a little to the northeast, crossing the Putnam-Kanawha county line just north of the common corner of Lincoln, Putnam, and Kanawha into Kanawha county, and extends along just east of the Putnam-Kanawha county line for about 3 miles; then it deflects to the northeast and dies out a short distance west of Lock Seven in the Kanawha river.

Milliken Anticline.—This arch originates near Rutledge about 5 miles north 84° east from Charleston, and extends in a general northern direction, crossing Elk river at Milliken station on the C. & C. R. R. (for which station it was named) about midway between the mouths of Mill and Cooper creeks, passing one mile west of Copenhaver P. O., crossing the dividing ridge between the waters of Elk and Pocatalico rivers between the head fountains of Aaron's fork of little Sandy creek and that of Leatherwood creek; thence one-half mile west of Blundon P. O., on Leatherwood creek, to the Pocotalico river, which river it crosses about one-third mile northeast of Island Branch P. O., from which place it deflects to the northwest and dies out near the Jackson-Kanawha county line, about one mile southwest of the common corner of Jackson, Roane, and Kanawha counties.

Warfield Anticline.—This great anticline enters West Virginia from Kentucky at Warfield on the Kentucky side and Kermit on the West Virginia side, and extends in a general northeastern direction through Mingo county just south of Dingess, entering Logan county near the head of Big Hart creek and crossing the Guyandotte river just south of Chapmansville, entering Boone county about 3 or 4 miles south of the common corner of Lincoln, Logan and Boone counties, passing through Boone county a short distance south of Madi-

son, then crossing Big Coal river near Peytona and entering Kanawha county at the head of Mary fork of Lens creek. It passes about one-half mile south of Hernshaw; thence in the same general direction as Lens creek and just south of said creek, intersecting the Kanawha river at mouth of Simmons creek, ¾ mile southeast of Marmet; thence about parallel with the general course of this creek to its source where it crosses the Cabin Creek-Malden district line, and thence to the head of the Left fork of Witchers creek where it again crosses the Cabin Creek-Malden district line and dies out near Eight P. O. at the mouth of Eight Mile fork of Campbell creek.

*Arches Fork Anticline.—"The Arches Fork anticline is a very prominent structural feature in Doddridge county, and it was so designated by the writer from a stream of that name in the southeastern portion of Wetzel county, on which occurs its northeastern terminus The axis of the fold enters Doddridge from Wetzel county at the extreme head of Talkington Fork of McElroy creek, and bears southwest, crossing Robinson fork 2 miles above Centerpoint and Flint run one mile west from Doak P. O. There it deflects slightly more to the west and crosses the Baltimore & Ohio railroad one-half mile west from Morgansville. It intersects South Fork of Hughes river near the mouth of Big run, 2½ miles below Kelly P. O.; then bears south about 10 degrees west, passing one-half mile west of the common corner of Doddridge, Ritchie and Gilmer counties.

"Northward from Doddridge the axis passes into Wetzel county, veers to the northwest roughly parallel with Arches Fork and dies down just before reaching Fishing creek into the Smithfield structural terrace, one mile west of the town of Smithfield.

"Southward from Doddridge the axis passes into Ritchie county, crossing the extreme eastern point of the latter area, 2 miles east of Auburn, and then veers to the southwest across Gilmer county, and intersects the Gilmer-Calhoun county line, 2¾ miles due north of the village of Whitepine. On entering Calhoun county the axis bears southwest and crosses the Little Kanawha river one mile northwest of Grantsville; West Fork river, one mile northwest of Altizer; Beech fork at Beech P. O.; and the Calhoun-Roane county line, one mile southwest of Beech P. O. Southwestward through Roane county the axis crosses Henry fork at Linden, passes through Nichols knob, and intersects the Roane-Kanawha county line 2½ miles westward from Cotton P. O."

Where this fold enters Kanawha county on the southwest, the top of the Kanawha Flint ledge has an elevation of about 1410 feet above tide on the crest of the arch. Northeast along this anticline the Kanawha Flint gradually falls for about 3 miles, to about 1260 feet above tide. Then for a short distance

*Doddridge-Harrison Report, pp. 55-56, W. Va. Geol. Survey, 1913.

east from Hernshaw along the crest of this fold the flint gradually rises into a marked dome 1340 feet above tide, where this anticline crosses the Kanawha river between Marmet and Belle. Then it gradually falls to the line where the key rock is changed from the Kanawha Flint to the Pittsburgh coal 2.3 miles south, 5.2 east from Blue Creek, where the Kanawha Flint is about 580 feet above tide and the Pittsburgh coal about 1310 feet above tide. Then it gradually falls from the Blue Creek oil field from 1310 to about 1125 feet above tide. Then it runs almost level for about six miles to the Kanawha-Roane county line.

Winifrede Anticline.—This fold probably has its origin in Boone county and enters Kanawha county 2 miles almost due west from Winifrede and extends almost due east from Winifrede, the town for which it was named. Thence in northwestern direction for about two miles, where it noses out in the western flank of the Coalburg syncline.

Hansford Anticline.—This anticline takes its origin about one mile northeast from Standard, and extends in a northwestern direction, passing one half mile east of Wacoma, crossing Paint creek at Mucklow, then it deflects gradually to the northeast and runs in an almost parallel course with Paint creek and just west of this stream to its mouth where it crosses the Kanawha river and continues in a northeastern direction to the head of Fourmile fork of Kelly creek where it deflects more to the east and crosses Hurricane fork of Kelly creek about one mile farther in the same course and dies out north of Spangler P. O.

Wake Forest Anticline.—Passing south from Crown Hill the measures are very flat until one reaches a northeast and southwest line passing through Ohley and Standard, then the measures begin a steady rapid rise and continue to rise rapidly until you reach Johnson Knob where they level off into the Wake Forest Anticline.

This anticline probably originates somewhere in Boone county, entering Kanawha county about one mile southwest of Acme and passing through the southern neck of Kanawha county in a northwestern direction, passing through Wake Forest (for which it was named) about ¾ of a mile south of Johnson Knob, about midway between Tomsburg and Green-

castle, entering Fayette county near the head of Toms branch of Paint creek.

Saint Albans Syncline.—This syncline or basin lies in the southwestern part of Kanawha county and northeastern part of Lincoln county. It originates in Lincoln and runs in a northwestern course, entering Kanawha county just west of the mouth of Island creek where it crosses Coal river, passing just east of Tornado P. O. or Upper Falls C. & O. R. R. station. At this point it deflects to the north and extends due north to Saint Albans where it dies out. It was so designated from this town.

Guthrie Syncline.—This basin lies principally in Union district, originating in the northern part of the district near Rocky Fork P. O. and bears in a general southeastern course passing near Aetna school house and just south of Guthrie P. O., dying out in the western slope of the Milliken anticline just north of Charleston.

Jarrett Syncline.—This trough lies in the northern part of Kanawha county and was so designated from a railroad station on K. & W. V. Railroad of the same name. It takes its origin on the western slope of the Warfield anticline in the southeastern end of the Blue Creek oil field as shown by the present development near the mouth of Indian creek and extends in a northern direction, crossing Elk river about one-half mile south of Pinchton P. O. and passing just west of Pinchton then due north one-half mile west of Jarretts Ford station, where it deflects to the east, running in a northeastern direction about one-fourth mile west of Jarrett station on the Kanawha & W. Va. R. R., and passing on northeast, ¾ mile east of Hammick Hill, crossing Wills creek 1.5 mile northeast of Hammick Hill. A short distance above where it crosses Wills creek it deflects to the northwest, passing just west of Hunt P. O., where it deflects to the north and extends in a general northern direction to the Boone-Kanawha county line near which it dies out.

Coalburg Syncline.—This is the largest syncline in Kanawha county, lying east of the Great Warfield anticline and almost paralleling it. It has been so designated by Krebs from a town of the same name. It originates somewhere

southwest of the Boone-Kanawha county line, entering Kanawha county near the heads of North and South hollows of Fields creek, 2 miles south 21° east from Winifrede, and extends in a northeastern direction, touching the sharp bend in Slaughter creek, ¾ mile south of Chelyan, crossing the Kanawha river near the mouth of Cabin creek between Cabin Creek Junction and Coalburg, and from thence parallels said river to Monarch, where it leaves the river, deflecting slightly more to the north and dies out just above the mouth of Little Ugly branch of Witchers creek.

Handley Syncline.—The Handley syncline lies southwest of the Hansford anticline and has been so named from a town of that name. It originates on eastern slope of the Hansford anticline near Hollygrove and extends in a northeastern direction, crossing the Kanawha river at Handley, where it deflects a little to the north, passing one mile east of Hugheston, crossing Hughes creek just east of the mouth of Buffalo fork, intersecting Shadrick fork about one mile north of its mouth; thence along the course of said stream to its source where it deflects again to the north, passing ½ mile east of Pond Gap and just west of Pond Gap P. O., where it deflects to the east, entering Clay county just north of the Cabin Creek-Elk district line and 2.3 miles north of the common corner of Clay, Nicholas, Fayette and Kanawha counties.

Quincy Syncline.—The Quincy syncline enters Kanawha county at the head of Lens creek and runs in a course just a little north of east to where it crosses the Left fork of Lens creek, 2 miles northwest of Winifrede, then in an eastern direction to where it crosses Fields creek, 1.5 mile southwest of Winifrede Junction, near where it deflects to the north and crosses the Kanawha river at Quincy, from which it was named, where it dies out on the western flank of the Coalburg syncline.

Miami Syncline.—This basin begins on the southern flank of the Coalburg syncline south of Chelyan and runs in a southeastern direction through Miami, near where it deflects to the south, passing 1-3 mile east of Eventon P. O. and dying out about 1.5 miles east of Ohley.

Robinson Syncline.—This syncline has its origin on the

eastern flank of the Warfield anticline in the Blue Creek oil field, about 2 miles west of Falling Rock and parallels this anticline, hugging up very closely on the eastern slope and following the general course of Wills creek to its head, then in a northeastern course to the Kanawha-Roane county line. From this point the description given by Mr. Ray V. Hennen in his Doddridge-Harrison detailed report, pages 61-63, follows:

"The Robinson syncline is the deep structural basin that lies between the Arches Fork and Wolf Summit anticlines and was so designated by the writer*, from a town of that name in the southeastern corner of Wetzel county, West Virginia, near which it passes on its northeast-southwest course across the latter area. When the writer first described this basin in the Marshall-Wetzel-Tyler report, mention was there made of the probability of this basin being an extension of the Waynesburg syncline of Greene county, Pennsylvania, but during the season of 1911 the field work for the western portion of Marion and Monongalia counties was completed, and it is found that the Robinson syncline extends north 10-20 degrees east from its type locality via Seven Pines, and passes slightly east from Glover Gap tunnel. From the latter region it follows closely along the Wetzel-Monongalia county line, and crosses the West Virginia-Pennsylvania State line near the northwest corner of Monongalia county. On the other hand, Stone & Clapp† show the axis of the Waynesburg syncline intersecting the same state line about six miles farther eastward, near the mouth of Pumpkin run of Dunkard creek; hence, the Robinson and Waynesburg syncline represent separate and distinct basins. The latter parties failed to name the former trough at its northern terminus in western Springhill township, so that the name 'Robinson' holds by right of priority.

"The axis of the latter fold enters the northwestern corner of Harrison from Wetzel county, bears slightly west of south, and crosses the W. Va. Short Line Branch of the Baltimore & Ohio Railroad at Rinehart station.

"From there it continues almost due south to a point about one mile northwest from Fonda P. O. where it veers to a south 30-35 degrees west course, passing about two miles eastward from Sedalia and three-fourths mile east from Cascara, and intersecting with the main line of the Baltimore & Ohio railroad, two miles west from Salem. There the axis of the trough swings slightly more to the west and crosses Buffalo Calf fork, one mile and three-fourths southeast from Long Run station; Buckeye fork, one-third mile northwest from Nina P. O.; and Meathouse fork, two miles southeast from the town of New Milton, near the mouth of Brushy fork. It still continues nearly the same southwest course, and crosses Cove creek one-third mile north of Leopold P. O., and the Doddridge-Gilmer county line 2¾ miles eastward from the common corner to Doddridge, Ritchie and Gilmer counties.

"Southward from Doddridge the axis passes through Gilmer

*Marshall-Wetzel-Tyler Report, page 69, W. Va. Geol. Survey, 1909.

†Bul. 304, Structural Map of Greene Co., Penna., U. S. Geol Survey.

county and intersects the Gilmer-Calhoun county line one mile northeast of the village of Whitepine. In Calhoun it bears south about 30 degrees west; passes through Sycamore P. O., and near Arnoldsburg; and crosses the Calhoun-Roane county line 2 miles eastward from Linden. In Roane the axis bears southwest, passing near Tariff, Bright, Lefthand and Clio post offices, and crosses the Roane-Kanawha county line 1¾ miles westward from Cotton P. O."

A glance at the structural contours of the top of the Pittsburgh coal bed and the Kanawha Black Flint as shown by the economic geologic map accompanying this report, will show that the strata of the Kanawha County Area are very much warped and twisted and that ideal conditions prevail for the segregation of petroleum and natural gas into pools of commercial value. In the southern part of the county the strata are rising so rapidly that the presence of petroleum in commercial pools is doubtful.

CHAPTER IV.

STRATIGRAPHY—GENERAL SECTIONS.

The outcropping stratified rocks of Kanawha county are included wholly in the Carboniferous, and the exposed beds extend from the base of the Dunkard series down through the Monongahela, Conemaugh, Allegheny and a portion of the Upper Pottsville or Kanawha series. The following table illustrates the several subdivisions of the stratified rocks of Kanawha county, some portions of which crop at the surface within this area:

Table of Geological Formations.

UPPER CARBONIFEROUS.

Dunkard or Permo-Carboniferous Series.
Monongahela Series.
Conemaugh Series.
Allegheny Series.
Pottsville Series.

Some general sections will now be given, illustrating the order and character of the several formations composing the rock column in Kanawha county made from exposures at crop and from records of the numerous borings for petroleum and natural gas, throughout the county, which pass into the underlying formations of the Mississippian and Devonian.

SECTIONS.

POCA DISTRICT.—The following section was measured by Krebs in the northeastern part of Poca district with aneroid from the summit of a high knob near the county line between Jackson and Kanawha counties, descending the hill to Island

Branch of Pocatalico river and connected to the Dr. Jones well (3).

Section 5½ Miles Northeast of Sissonville, Poca District.

	Thickness Feet	Total Feet	
Dunkard Series (85')			
Sandy shale and concealed	25	25	
Sandstone massive, conglomerate, Waynesburg	60	85	85'
Monongahela Series (263')			
Red shale and fire clay, Waynesburg	3	88	
Concealed	12	100	
Sandstone, Gilboy	25	125	
Red shale with limestone nodules	10	135	
Sandy shale and sandstone, Uniontown	35	170	
Red shale	5	175	
Sandstone, coarse grained, Arnoldsburg	25	200	
Sandy shale and sandstone	25	225	
Dark red shale	22	247	
Sandy shale and sandstone	20	267	
Red shale	10	277	
Sandstone, Sewickley	23	300	
Red shale	10	310	
Sandstone .....20' / Sand .....18 } Pittsburgh Sandstone	38	348	263
Top of Dr. Jones' Well (600)			
Conemaugh Series (582')			
Slate	152	500	
Coal, Little Clarksburg	2	502	
Slate	48	550	
Sand	30	580	
Red rock	80	660	
Pink rock and slate	140	800	
Sand	30	830	
Sandy lime	85	915	
Dark lime	15	930	582
Allegheny Series (245')			
Black sand	70	1000	
Coal, (Lower Freeport?)	3	1003	
Black slate	12	1015	
Sand	10	1025	
Lime	10	1035	
Sand	45	1080	
Brown slate	25	1105	
Sand	10	1115	
Brown shale	60	1175	245'
Pottsville Series (825')			
Sandy lime	15	1190	
Sand	95	1285	
Black slate	70	1355	
Sand	10	1365	
Black slate and lime shales	95	1460	
Sand	10	1470	
Black slate and shales	15	1485	
Salt sand, (New River)	515	2000	825'

	Thickness Feet.	Total Feet.	
Mississippian (235')			
Red lime	45	2045	
Pencil cave	13	2058	
Big lime	125	2183	
Pocono sandstones (Big Injun)	52	2235	235'

The preceding section shows the interval between the base of the Monongahela Series and top of Big Lime to be 1610 feet.

Another section was obtained by combining the record of the Milam well No. 1 (606), located at the mouth of Middle Fork of Pocatalico river with a section measured with aneroid by the writer, southwest, descending from a summit of a high knob one-half mile south of Jackson-Kanawha county line toward Pocatalico river:

Section 1 Mile Northeast of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Serics (135')			
Sandstone	20	20	
Sandy shale and concealed	30	50	
Sandstone, massive, conglomerate, Waynesburg	85	135	135'
Monongahela Series (291')			
Fire clay, (Waynesburg coal horizon)	1	136	
Shale and concealed	30	166	
Sandstone and concealed, Gilboy	25	191	
Red shale and concealed	25	216	
Sandstone, flaggy	35	251	
Red shale and concealed	55	306	
Sandstone and concealed (Mostly sandstone; Pittsburgh coal horizon)	120	426	291'
Conemaugh Series (535')			
Sandy shale and concealed	10	436	
Sandstone, flaggy	25	461	
(Top of boring 627' A. T. L.)			
Surface	47	508	
Red rock	60	568	
Sand	25	593	
Red rock	70	663	
Lime	20	683	
Red rock	50	733	
Lime	25	758	
Red rock	40	798	
White slate	51	849	
Red rock	112	961	535'

Allegheny and Pottsville Series (1021')			
Grit lime	275	1236	
Coal	2'-6"	1238'-6"	
Lime	333'-6"	1572	
Sand	10	1582	
Limestone	25	1607	
Salt sand(?)	375	1982	1021'
Mississippian (672')			
Big lime (Greenbrier Limestone)	145	2127	
Big Injun sand?	90	2217	
Lime	108	2325	
Slate	285	2610	
Black slate	30	2640	
Berea sand	14	2654	672'

The above section shows the interval between the base of the Pittsburgh sandstone and the Berea sandstone to be 2214 feet.

The following section was measured by Krebs with aneroid descending from the summit of a high knob south of Blundon northward to Leatherwood creek, Poca district:

Section 1 Mile Southeast of Blundon P. O., Poca District.

	Thickness Feet	Total Feet	
Monongahela Series (187')			
Sandstone, Uniontown	45	45	
Red shale	30	75	
Sandy shale mixed with red	23	98	
Sandstone	32	130	
Sandy shale	8	138	
Red limy shale	7	145	
Sandstone, massive, conglomerate, Pittsburgh	41	186	
Fire clay (Pittsburgh coal)	1	187	187'
Conemaugh Series (207')			
Sandy shale	10	197	
Sandstone, medium coarse grained (Lower Pittsburgh)	38	235	
Red and sandy shale	17	252	
Sandstone, massive, Connellsville	60	312	
Coal blossom, Little Clarksburg	2	314	
Fire clay	3	317	
Red limy shale	110	427	
Sandstone ....23' / Red shale..... 4 / Sandstone ....40 } (Morgantown) Elev. 728' A. T. B.	67	494	207'

The following section was measured by Krebs with aneroid, descending from a high summit of a knob eastward to Dudden fork, one mile east of Goldtown, Ripley district,

Jackson county, and two miles east of the Jackson-Kanawha county line, and combined with Boggess well:

Section One Mile East of Goldtown, Ripley District, Jackson County.

	Thickness Feet	Total Feet	
Dunkard Series (217')			
Sandstone	25	25	
Shale and concealed	20	45	
Coal blossom, Washington	2	47	
Red and sandy shale	15	62	
Sandstone	40	102	
Red and sandy shale, mixed	35	137	
Sandstone, conglomeratic (Waynesburg)	80	217	217'
Monongahela Series (253')			
Red and dark shale (Waynesburg coal horizon)	5	222	
Red shale	15	237	
Sandstone and shale to top of well, Elev. 660' A. T. B., thence with well	50	287	
Gravel	18	305	
White slate	4	309	
Lime	3	312	
Red rock	10	322	
Sand	24	346	
Red rock	6	352	
White slate	10	362	
Red rock	10	372	
White slate	11	382	
Red rock	8	391	
White slate	20	411	
Red rock	8	419	
Sand	22	441	
Slate	5	446	
Lime	19	465	
Red rock	5	470	253'
Conemaugh Series (509')			
White slate	24	494	
Sandstone (Lower Pittsburgh)	32	526	
White slate	34	560	
Red rock	6	566	
White slate	45	611	
Red rock	25	636	
Lime and shells	58	694	
White slate	2	696	
Red rock	85	781	
White slate	20	801	
Sand	15	816	
White slate	10	826	
Lime	5	831	
Slate	10	841	
Sand	23	864	
White slate	15	879	
Sand	35	914	
White slate	35	949	

	Thickness Feet.	Total Feet.	
First Cow Run sand	30	979	509′
Allegheny Series (201′)			
White slate	30	1009	
Black slate	15	1024	
Big Dunkard sand, water	85	1109	
Black slate	35	1144	
Sand	10	1154	
Slate	26	1180	201′
Pottsville Series (394′)			
First Salt sand (Homewood)	34	1214	
Black slate	60	1274	
Second Salt sand	5	1279	
Black slate	10	1289	
Lime	20	1309	
Black slate	10	1319	
Third Salt sand	115	1434	
Water	90	1524	
Hole full of water	50	1574	394′
Mississippian (859′)			
Pencil cave	210	1784	210′
Greenbrier lime (105′)			
Lime	15	1799	
Gray sand	10	1809	
Big lime	80	1889	105′
Pocono Sandstone (544′)			
Big Injun (Water)	109	1998	
Black slate	76	2074	
Black sandy lime, very hard	10	2084	
Lime shells	115	2199	
Black slate	10	2209	
Lime shells	139	2348	
Brown shale	60	2408	
Berea grit, little gas	25	2433	544′

The above section shows the thickness of the different strata in the northern part of the Kanawha county area.

The interval between the base of the Pittsburgh sandstone and the top of the Berea sand is 1,882 feet, compared with 2,216 feet in the Sissonville section, a thickening of 334 feet in 4½ miles in a southern direction or 76 feet per mile.

UNION DISTRICT.—Union district lies west of Poca and in the northwestern part of Kanawha county. Several general sections will now be given therein to show the rock succession.

The following section was measured by Krebs in the southern part of Union district with aneroid from the summit of a high knob westward to the right fork of Two-mile creek ½ mile south of Guthrie:

Section One-half Mile South of Guthrie, Union District.

	Thickness Feet	Total Feet	
Monongahela Series (171')			
Sandy shale and concealed	120	120	
Sandstone, Pittsburgh	47	167	
Coal, Pittsburgh	4	171	171'
Conemaugh Series (402')			
Sandy shale and sandstone, Lower Pittsburgh	49	220	
Sandy shale	21	241	
Red shale	7	248	
Sandstone	8	256	
Sandstone, massive, Connellsville	45	301	
Red shale	40	341	
Sandy shale	3	344	
Sandstone	20	364	
Red shale, limestone nodules	10	374	
Red shale	4	378	
Sandstone, shelly	23	401	
Sandy shale	15	416	
Red shale	5	421	
Sandstone, Grafton	30	451	
Sandy shale and concealed	48	499	
Limestone, Upper Ames	2	501	
Sandy shale and concealed	45	546	
Red shale and lime, Lower Ames	5	551	
Sandstone, massive, Saltsburg	20	571	
Coal, Bakerstown	2	573	402'

The foregoing section shows the interval between the Bakerstown coal and the Pittsburgh coal to be 400 feet, and to this if we add 150 feet down to the Upper Freeport coal horizon it gives the thickness of the Conemaugh series 550 feet at this point.

The following section was measured with aneroid by Teets, descending from a high summit 1.3 miles south of Wallace P. O., passing by the U. B. Young coal opening and combining the section with the record of the Wythe Haynes well No. 1 on branch of Tupper creek nearby:

Section 1.3 Miles South of Wallace P. O., Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (96')			
Concealed	50	50	
Sandstone	40	90	
Coal, good, Pittsburgh	6	96	96'

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny-Pottsville Series (1599')			
Sandstone and concealed	39	135	
Sandstone, massive	45	180	
Red and sandy shale to top of well. Elevation top of well No. 1, 810' A. T. B. Thence continuing with well.	25	205	
Unrecorded	995	1200	
Sand	85	1285	
Unrecorded	155	1440	
Coal	3	1443	
Sand	252	1695	1599'
Mississippian (810')			
Black lime	12	1707	
Unrecorded	153	1860	
Big lime, (Greenbrier)	170	2030	
Sand (Big Injun)	68	2098	
Slate	387	2485	
Sand, Berea	15	2500	
Slate	5	2505	810'

The foregoing section gives the interval between the bottom of the Pittsburgh coal and top of Berea sandstone 2,389 feet, compared with 2,216 feet in the Sissonville section, given on page 68 of this volume, a gradual thickening of the measures of 173 feet.

Another section was measured with aneroid by Teets descending from a high summit on the ridge between Howard fork and Rocky fork of Pocatalico river, northeastward and joined on to Rust well No. 1 (629), 3 miles southwest of Rocky Fork P. O.

Section Three Miles Southwest of Rocky Fork P. O., Union District.

	Thickness Feet	Total Feet	
Monongahela Series (100')			
Red shale	10	10	
Sandy shale	10	20	
Sandstone, massive, coarse grained buff color, Pittsburgh	50	70	
Sandy shale and concealed	25	95	
Coal, medium hard. 4' 0" / Coal, softer. 0 6 / Coal, soft. 0 6 } Pittsburgh	5	100	100'
Conemaugh Series (515')			
Sandy shale and sandstone	50	150	
Sandy shale	20	170	
Red shale	10	180	
Sandstone, massive	15	195	
Red and sandy shale	35	230	

	Thickness Feet.	Total Feet.	
Sandstone and sandy shale	70	300	
Red shale	10	310	
Sandy shale	20	330	
Sandstone, massive, Morgantown	35	365	
Limestone, impure	1	366	
Sandstone and concealed to top of Rust well No. 1 (618)	29	395	
Loose earth	30	425	
Slate and shells	190	615	515'
Allegheny Series (140')			
Sand	80	695	
Slate	60	755	140'
Pottsville Series (840')			
Sand, Homewood	130	885	
Slate	20	905	
Sand	15	920	
Slate	20	940	
Sand	105	1045	
Slate	70	1115	
Sand	15	1130	
Slate	15	1145	
Sand ..... 40' / Slate .....245 / Sand .....165 } New River Series	450	1595	840'
Mauch Chunk (215')			
Black lime	20	1615	
Slate	100	1715	
Sand	80	1795	
Black lime	15	1810	215'
Big lime (Greenbrier)	185	1995	185'
Pocono Series (510')			
Slate	10	2005	
Big Injun	54	2059	
Slate and shells	416	2475	
Berea Grit	15	2490	
Slate	15	2505	510'

The foregoing section shows the interval between base of Pittsburgh coal and top of Berea sandstone to be 2,375 feet, compared with 2,216 in the Sissonville section on page 68 of this volume.

ELK DISTRICT.—Elk district lies east of Poca and Union districts, and borders Roane county for a short distance on the north, and Clay county for a short distance on the east, and lies on both sides of Elk river.

A section was measured with aneroid by Krebs, descending from a high summit on the ridge between Coopers creek and Sigman fork, eastward into Five-mile fork of Coopers creek, 5 miles north of Barlow, Elk district.

Section Five Miles North of Barlow, Elk District.

	Thickness Feet	Total Feet	
Monongahela Series (104')			
Concealed	30	30	
Sandstone, massive, Pittsburgh	68	98	
Coal, Pittsburgh	6	104	104'
Conemaugh Series (263')			
Sandstone, Lower Pittsburgh	46	150	
Sandy shale	10	160	
Sandstone, Connellsville	32	192	
Sandy shale	16	208	
Red shale	15	223	
Sandy shale	8	231	
Fire clay, (Little Clarksburg coal)	2	233	
Red and sandy shale	33	266	
Sandstone, coarse grained, Morgantown	20	286	
Red shale and limestone nodules	12	298	
Sandstone	5	303	
Red shale and limestone nodules	17	320	
Sandstone	3	323	
Red shale and limestone nodules	9	332	
Sandstone, friable, Grafton	20	352	
Red shale, Elev, 780' A. T. B	15	367	263'

The following section was measured with aneroid by Teets from the top of a high summit south of Elk river, descending eastward to Elk river at Walgrove and combined with A. P. Hayes well No. 14 (412), Elk district:

Section at Walgrove, Elk District.

	Thickness Feet	Total Feet	
Monongahela Series (100')			
Sandstone, massive, conglomerate	85	85	
Red and sandy shale (Pittsburgh coal horizon)	15	100	100'
Conemaugh-Allegheny-Pottsville Series (1681')			
Sandstone, massive, medium coarse grained	40	140	
Red shale, dark	25	165	
Sandstone and sandy shale	20	185	
Red shale	15	200	
Sandstone and concealed	20	220	
Red shale	2	222	
Sandstone, massive, medium coarse grained, Morgantown	93	315	
Sandy shale	10	325	
Red and sandy shale	10	335	
Sandy shale and sandstone and red streaks, Grafton	60	395	
Red shale	5	400	
Sandy shale and concealed	50	450	
Sandstone, massive, medium coarse grained, Buffalo	35	485	

	Thickness Feet.	Total Feet.	
Fire clay, Brush Creek coal	5	490	
Sandstone, massive, medium coarse-grained to top of A. P. Hayes Well No. 14	45	535	
Soil	22	557	
Slate	24	581	
Sand	140	721	
Coal (No. 5 Block)	5	726	
Slate	15	741	
Slate and shells	245	968	
Sand	215	1201	
Slate and shells	30	1231	
Salt sand	550	1781	1681'
Mississippian (449')			
Mauch Chunk Series (160')			
Lime	15	1796	
Slate and shells	20	1816	
Sand, Maxton	35	1851	
Slate	30	1881	
Little lime	15	1896	
Slate and shells	45	1941	160'
Big lime, (Greenbrier)	130	2071	
Sand, Big Injun	45	2116	
Slate and shells	104	2220	
Sand, Squaw	10	2230	449'

The following section was measured with aneroid by Teets from the top of a high summit southwestward along road to mouth of Pincheon Camp Branch of Blue creek, ¾ mile southwest of Odell P. O., Elk district:

Section Three-fourths Mile Southwest of Odell P. O., Elk District.

	Thickness Feet	Total Feet	
Conemaugh Series (200')			
Red clay	27	27	
Sandstone and sandy shale	93	120	
Fire clay	3	123	
Sandstone, massive, medium coarse grained, Mahoning	77	200	200'
Allegheny Series (120')			
Coal blossom, (Upper Freeport)	2	202	
Sandy shale	28	230	
Fire clay	3	233	
Sandstone, massive, East Lynn	42	275	
Coal 0' 5" / Coal, bone 0 4 / Coal 1 2 / Slate 0 6 / Coal (vis) 0 7 — (No. 5 Block) (Middle Kittanning)	3	278	
Sandstone	32	310	
Sandy shale	10	320	120'

	Thickness Feet.	Total Feet.	
Kanawha Series (204')			
Sandstone .....30'			
Sandy shale.....20 } Homewood	75	395	
Sandstone, massive.25			
Sandy shale and concealed.....	30	425	
Kanawha Black Flint	4	429	
Concealed	25	454	
Coal blossom (Stockton-Lewiston).....	2	456	
Sandstone, massive, (Coalburg).....	66	522	
Coal blossom (Coalburg?), Elevation, 696' A. T. L.	2	524	204'

In this region the Allegheny series appears to thin down locally to only 120 feet, while at Mason, a few miles further down Elk, the entire thickness of the series appears to be only 40 to 50 feet.

The following section was measured by Krebs with aneroid from a high summit on the ridge between Cooper creek and Little Sandy creek, westward to Cooper creek near its mouth, one mile northwest of Bream, Elk district:

Section One Mile Northwest of Bream, Elk District.

	Thickness Feet	Total Feet	
Conemaugh Series (501')			
Red shale	5	5	
Sandstone, massive, conglomeratic, Lower Pittsburgh	50	55	
Red and sandy shale.....	10	65	
Sandstone, massive, buff.....	50	115	
Red shale	28	143	
Limy shale	2	145	
Red limy shale	45	190	
Sandstone and concealed, Morgantown....	45	235	
Red and sandy shale.....	30	265	
Dark red shale.....	25	290	
Sandy shale and sandstone.....	35	325	
Red and sandy shale.....	40	365	
Sandy shale and sandstone.....	48	413	
Limy shale	2	415	
Sandstone and concealed, Buffalo.....	48	463	
Slate and fire clay, Brush creek.....	2	465	
Sandstone, massive, Mahoning.....	36	501	501'
Allegheny Series (29')			
Upper Freeport coal.....	4	505	
Sandstone and concealed.....	25	530	29'

BIG SANDY DISTRICT.—Big Sandy district lies north and east of Elk district and forms a portion of the northeastern part of Kanawha county. The following section was meas-

ured with aneroid by Teets, descending from the top of a high knob along county road to Falling Rock creek, one-half mile above the mouth of Horse Fork, and one-half mile south of Apgah P. O.:

Section One-half Mile South of Apgah P. O., Big Sandy District.

	Thickness Feet	Total Feet	
Conemaugh Series (205')			
Red shale	10	10	
Sandy shale and concealed	35	45	
Sandstone, massive, coarse grained, Saltsburg	35	80	
Fire clay (Bakerstown Coal)	2	82	
Sandy shale	18	100	
Sandstone, massive, coarse grained, friable (Buffalo)	45	145	
Fire clay (Brush Creek coal horizon)	2	147	
Sandy shale	23	170	
Sandstone, massive coarse grained, (Mahoning)	35	205	205'
Allegheny Series (150')			
Sandy shale and sandstone	95	300	
Fire clay	2	302	
Sandstone and concealed, East Lynn	43	345	
Sandy shale	9	354	
Coal blossom (No. 5 Block)	1	355	150'
Upper Kanawha Series (90')			
Sandstone, massive, medium coarse grained, Homewood, Elev. 865' A. T. B.	90	445	90'

Another section was obtained by Teets with aneroid descending hill from a high summit north of Clendenin, southward to Elk river, and combined with the Edward Jarrett well No. 1 (580), at Clendenin:

Section at Clendenin, Big Sandy District.

	Thickness Feet.	Total Feet.
Conemaugh-Allegheny-Pottsville Series (1719')		
Concealed and sandstone	20	20
Concealed	20	40
Concealed and sandstone, Morgantown	55	95
Red shale	15	110
Sandstone and concealed	30	140
Red shale	5	145
Sandstone	15	160
Red shale	5	165
Sandstone, flaggy	15	180
Concealed	20	200
Sandstone, flaggy	15	215

	Thickness Feet.	Total Feet.	
Concealed	15	230	
Sandstone, massive	15	245	
Red shale	5	250	
Sandstone, massive, Saltsburg	30	280	
Concealed and sandy shale	20	300	
Sandstone	25	325	
Sandy shale	15	340	
Sandstone, massive, Buffalo	45	385	
Sandy shale	5	390	
Sandstone, massive, cliff, medium coarse grained, Mahoning and East Lynn	80	470	
Blue shale	18	488	
Sandstone, massive to top of Edward Jarrett well No. 1, thence with well			
Soil	16	504	
Reddish clay	5	509	
Sand and gravel	63	572	
Sand, white	51	623	
Lime	10	633	
Black slate and shells	135	768	
Sand	20	788	
Slate and shells	170	958	
Sand	20	978	
Slate, black	70	1048	
Sand	30	1078	
Slate	95	1173	
Lime, sandy	12	1185	
Slate, white	9	1194	
Salt sand	409	1603	
Slate, white	12	1615	
Sand	104	1719	1719'
Mississippian (424')			
Mauch Chunk Series (84')			
Slate, black	6	1725	
Sand, Maxton	50	1775	
Little lime	20	1795	
Pencil cave	8	1803	84'
Big Lime (Greenbrier Limestone)	149	1952	149'
Pocono Sandstone (191')			
Sand broken, Big Injun	131	2083	
Sand, Squaw gas	60	2143	191'

The following section was measured with aneroid by Krebs, descending westward from a high summit, between Jordan creek and Sand branch to mouth of Sand branch, and combined with C. T. Wood well No. 5 (321), one mile southeast of Walgrove, Big Sandy district:

Section One Mile Southeast of Walgrove, Big Sandy District.

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny-Pottsville Series (1747')			
Sandstone, massive, capping knob, Lower Pittsburgh	85	85	
Red shale	15	100	
Sandstone, massive, Lower Pittsburgh	30	130	
Red limy shale	50	180	
Sandstone	15	195	
Red shale	30	225	
Sandstone, massive, buff, Morgantown	80	305	
Red and sandy shale	50	355	
Sandstone, massive, Grafton	60	415	
Sandy and red shale	8	423	
Fire clay	2	425	
Sandy and red shale	30	455	
Sandstone, shelly	50	505	
Slate	2	507	
Sandstone to top of C. T. Wood No. 5 well (321) Thence continuing with well Sandstone	16	523	
Slate and shells	624	1147	
Sand	50	1197	
Slate	160	1357	
Salt sand	390	1747	1747'
Mississippian (473')			
Mauch Chunk (150')			
Red rock	15	1762	
Slate	25	1787	
Lime	10	1797	
Slate	15	1812	
Lime	15	1827	
Red rock	15	1842	
Lime	10	1852	
Slate	10	1862	
Sand, Maxton	30	1892	
Slate	5	1897	150'
Greenbrier Limestone (205')			
Lime	65	1962	
Big lime	140	2102	205'
Pocono Sandstone (118')			
Slate and shells, Big Injun	106	2208	
Oil sand, Squaw	12	2220	118'

The following section was measured by Krebs with aneroid from top of Crab Apple knob southwestward, descending into Jordan's creek, and combined with the Wood well No. 1 (500), 2½ miles northwest of Clendenin, Big Sandy district:

Section Two and One-half Miles Northwest of Clendenin, Big Sandy District.

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny-Pottsville Series (1785')			
Sandstone, massive, Lower Pittsburgh...	60	60	
Red shale	40	100	
Sandstone, Connellsville	60	160	
Red limy shale.....	70	230	
Limestone, Clarksburg	2	232	
Sandstone, Morgantown	38	270	
Red shale	20	290	
Red sandy shale	35	325	
Red limy shale	35	360	
Sandstone, medium coarse grained, Grafton	40	400	
Red and sandy shale.....	14	414	
Sandstone	1	415	
Red shale and concealed to top of Wood Well No.1 (500) thence continuing with well	18	433	
Yellow clay	13	503	
Sand, white, hard.....	32	535	
Slate, soft	5	540	
Sand, white, hard	100	640	
Slate, dark.....	8	648	
Sand, white, soft.....	107	755	
Slate, dark, soft.....	225	980	
Sand, white, hard.....	45	1025	
Slate, dark, soft.....	110	1135	
Sandy lime, white.....	25	1160	
Slate, dark, soft.....	65	1225	
Sand, white	40	1265	
Slate, dark	120	1385	
Salt sand, hard	400	1785	1785'
Mississippian (343')			
Mauch Chunk (178')			
Slate, lime and shells	35	1820	
Sand, dark (Maxton).....	40	1860	
Slate, dark, soft.....	15	1875	
Rock, red	10	1885	
Slate, dark	30	1915	
Little lime	43	1958	
Pencil cave	5	1963	178'
Big lime, Greenbrier	138	2101	138'
Big Injun, (gas).....	27	2128	27'

The above section is very interesting, since it begins near the Pittsburgh coal horizon and extends to the Big Injun sand.

The following section was measured by Ray V. Hennen from the top of a high knob at the corner of Roane and Kanawha counties, northward down a private road to Big Sandy creek at the mouth of Wierlong run, and published in Wirt, Roane and Calhoun county report, page 94:

Section 1.7 Miles East of Osbornes Mills, Geary District, Roane County.

		Thickness Feet.	Total Feet.	
Monongahela Series (45')				
Concealed from top of high knob at corner of Roanoke-Kanawha line		45	45	45'
Conemaugh Series (530')				
Sandstone, coarse.....25'	Lower Pittsburgh	70	115	
Concealed along flat...20				
Sandstone, coarse.....25				
Concealed		70	185	
Dark reds		10	195	
Sandstone, green, micacous, shaly		35	230	
Concealed and reds		70	300	
Sandstone, coarse, friable on top, Grafton		30	330	
Concealed and reds		50	380	
Concealed		40	420	
Sandstone, coarse, grayish white, Saltsburg		30	450	
Concealed		15	465	
Massive sandstone, coarse, grayish white and pebbly (Buffalo)		41	506	
Coal, Brush Creek		4	510	
Sandstone, massive to fork of road, (U. S. 660' A. T.) opposite mouth of Wierlong run		55	565	
Concealed to Big Sandy creek		10	575	530'

MALDEN DISTRICT.—Malden district lies south and west of Elk district and east of Loudon district.

The following section was measured with aneroid by Krebs descending from a high knob between Clover hollow and Young branch, in a southwestern direction, into Clover hollow at its mouth, and combined with the W. S. Lewis well No. 1 (661), two miles east of Dana:

Section Two Miles East of Dana, Malden District.

	Thickness Feet	Total Feet	
Conemaugh Series (233')			
Sandstone and concealed, Grafton	55	55	
Red and sandy shale	10	65	
Sandstone	20	85	
Red shale, Pittsburgh Reds	30	115	
Sandstone and concealed, Saltsburg-Buffalo	70	185	
Fire clay (Brush Creek coal)	1	186	
Sandstone and concealed, Mahoning	47	233	233'
Allegheny Series (110')			
Fire clay, Upper Freeport	2	235	
Sandstone and concealed	30	265	
Fire clay	1	266	

	Thickness Feet.	Total Feet.	
Sandstone and concealed	39	305	
Fire clay	1	306	
Sandstone and concealed, East Lynn	34	340	
Coal, No. 5 Block	3	343	110'
Kanawha Series (791')			
Sandstone and concealed, Homewood	102	445	
Kanawha Flint Ledge	5	450	
Sandstone and concealed	30	480	
Coal blossom, Stockton	5	485	
Sandstone and concealed	140	625	
Coal blossom, Winifrede	5	630	
Sandstone and concealed	110	740	
Coal blossom, (Thacker?)	2	742	
Sandstone and concealed	128	870	
Coal blossom, Cedar Grove	2	872	
Concealed to top W. D. Lewis well No. 1	8	880	
Sand and gravel	22	902	
Sand and slate	30	932	
Coal, No. 2 Gas, (Campbells Creek)	4	936	
Sand	62	998	
Slate	12	1010	
Sand	28	1038	
Slate	7	1045	
Sand	86	1131	
Coal, Little Eagle	3	1134	791'
Middle and Lower Pottsville (594')			
Lime and sand	86	1220	
Slate	10	1230	
Sand	7	1237	
Slate	4	1241	
Lime	9	1250	
Sand	60	1310	
Slate	10	1320	
Lime	32	1352	
Sand 183' / Slate and lime shells. 65 / Lime 25 / Sand 15 / Lime 25 / Sand 63 — "Salt sand"	376	1728	594'
Mauch Chunk (48')			
Slate and shells	28	1756	
Lime	16	1772	
Pencil cave	4	1776	48'
Big lime, Greenbrier	239	2015	
Sand, white 45' / Sand, conglomeratic 20 — Big Injun	65	2080	
Red rock	25	2105	
Sand, black, limy, Squaw	15	2120	
Slate and shells	145	2265	
Slate	55	2320	
Slate and shells to bottom	497.5	2817.5	

The above section gives the interval between the Kanawha Black Flint and the No. 2 Gas coal (Campbell's Creek) seam, 482 feet.

Another section was measured by Teets with aneroid, descending from a high point between George creek and the Kanawha river, southward to the K. & M. R. R. depot at Malden:

Section at Malden, Malden District.

Kanawha Series (600')		Thickness Feet	Total Feet	
Sandstone and sandy shale		10	10	
Sandstone, massive, coarse grained (Homewood)		90	100	
Sandy shale and concealed		15	115	
Kanawha Black Flint		4	119	
Sandy shale and concealed		21	140	
Sandstone, massive (Coalburg)		70	210	
Sandy shale and concealed		35	245	
Sandy shale and concealed, mostly sandstone		80	325	
Concealed		125	450	
Sandstone		50	500	
Concealed		75	575	
Shale roof				
Coal 2' 3"				
Fire clay 0 3	No. 2 Gas (Campbells Creek)	4	579	
Coal 0 5				
Slaty fire clay 0 4				
Coal (Vis) 0 9				
Concealed to K. & M. R. R. level at Malden. (Elev. 605' A. T. L.)		21	600	600'

The above section gives the interval between the Kanawha Flint ledge and No. 2 Gas coal, 460 feet.

The following section was measured by Krebs with aneroid, descending from a high hill westward, along road to Eight-mile Fork of Campbell's creek, 2.5 miles northwest of Putney, Malden district:

Section 2.5 Miles Northwest of Putney, Malden District.

Conemaugh Series (270')	Thickness Feet	Total Feet	
Sandstone and concealed	50	50	
Sandy shale	5	55	
Sandstone and sandy shale	92	147	
Fire clay	3	150	
Sandy shale and concealed, Mahoning	120	270	270'

	Thickness Feet.	Total Feet.	
Allegheny Series (140')			
Fire clay	2	272	
Sandy shale and concealed	58	330	
Fire clay	2	332	
Sandy shale and concealed, East Lynn	74	406	
Coal blossom (No. 5 Block)	4	410	140
Kanawha Series (140')			
Sandy shale and sandstone	60	470	
Sandy shale and concealed	15	485	
Dark shale	2	487	
Sandy shale and sandstone	23	510	
Kanawha Flint ledge	5	515	
Sandy shale and sandstone	30	545	
Coal block (good) 1' 6" / Impure coal 2 6 / Coal block (vis) 1 0 — (Stockton Lewiston)	5	550	140'

Elev. 960' A. T. B.

The following section was measured with aneroid by Teets, descending from a point one mile southeast of Snow Hill station and at head of Valley Grove branch, southeastward along the county road to Dry branch at a point one mile northeast of Kanawha river:

Section One Mile Northeast of Snow Hill, Malden District.

	Thickness Feet	Total Feet	
Allegheny Series (142')			
Sandstone, massive, friable, coarse	50	50	
Sandy shale	10	60	
Sandstone, massive, coarse, East Lynn	50	110	
Sandy shale	5	115	
Fire clay	2	117	
Sandstone	23	140	
Fire clay, No. 5 coal	2	142	142'
Kanawha Series (378')			
Sandstone and concealed	38	180	
Sandstone, massive, Homewood	80	260	
Kanawha Black Flint	3	263	
Sandy shale and slate, Stockton-Lewiston coal	6	269	
Sandstone, massive, Coalburg	36	305	
Coal 0'—3" / Shale 0'—4" / Coal, soft 2'—4" / Fire clay 0'—9" / Coal block 1'—4" — Coalburg coal	5	310	
Fire clay floor.			
Sandstone (Winifrede)	90	400	
Coal, good 2' / Sandy shale 4' / Coal 1' — Winifrede	7	407	
Sandstone, massive (Lower Winifrede)	113	520	378'

The above section gives the interval between the Winifrede coal and the Kanawha Black Flint as 137 feet, but as the section was taken going towards the rise, the proper interval is about 20 feet more or 157 feet.

JEFFERSON DISTRICT.—Jefferson district is bounded on the north by Union district, the Kanawha river forming the boundary line. It is the most western district in Kanawha county. A section was obtained by Krebs, in measuring with aneroid from the top of a high knob on the north side of Kanawha river, southward to the river, and combined with the Coal River Oil & Gas well No. 1 (626) at Lewis as follows:

Section at Lewis, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (55')			
Sandstone, massive, coarse grained.....	50	50	
Red shale and concealed (Pittsburgh coal horizon)	5	55	55'
Conemaugh Series (590')			
Concealed	40	95	
Sandstone, flaggy, micaceous	55	150	
Red shale	50	200	
Sandstone and shale	86	286	
Red shale, limestone nodules	40	326	
Sandstone, Morgantown (quarried for building purposes)	30	356	
Fire clay, mixed with iron nodules.....	4	360	
Dark sandy shale	40	400	
Concealed to top of well	35	435	
Quick sand and gravel	47	482	
Lime and pink rock	103	585	
Sand	60	645	590'
Allegheny Series (115')			
Slate, white (Upper Freeport coal horizon)	5	650	
Sand	45	695	
Coal, very good, Upper Kittanning.....	5	700	
Sand, East Lynn	55	755	
Coal, very good, No. 5 block.....	5	760	115'
Pottsville Series (885')			
Sand, Homewood	65	825	
Slate, black, Stockton-Lewiston coal horizon	5	830	
Sand	65	895	
Coal, poor (Coalburg).....	4	899	
Sand	11	910	
Sandy lime	10	920	
Sand	10	930	
Pink rock	5	935	
Sand	10	945	

	Thickness Feet.	Total Feet.	
Slate (6" casing)	40	985	
Lime	30	1015	
Sand	10	1025	
Slate and shells	10	1035	
Sandy lime	30	1065	
Slate	20	1085	
Broken lime	160	1245	
Top salt sand	60	1305	
"Little break," sand	2	1307	
Sand	120	1427	
Slate	18	1445	
Sand, Nuttall	200	1645	885'
Mississippian (805')			
Mauch Chunk (90')			
Slate	45	1690	
Red rock	10	1700	
Lime	15	1715	
Black lime	20	1735	90'
Big lime, Greenbrier	205	1940	205'
Pocono Sandstones (510')			
Slate	15	1955	
Big Injun sand	50	2005	
Shells and slate	170	2175	
White slate	215	2390	
Black slate	37	2427	
Berea Grit sand	23	2450	510'
Devonian (560')			
Black lime	15	2465	
Black slate	150	2615	
White slate	200	2815	
Black slate to bottom	195	3010	560'

The preceding section gives the interval from the base of the Pittsburgh sandstone to the top of the Berea sand 2377 feet, as compared with 2234 feet in the Sissonville section, an increase of 143 feet to the southwest.

The following section was measured from a high point above the William Taylor coal bank and divide between Smith creek and Two Mile and Three Quarter Mile creeks, near the Jefferson-Washington district line descending the hill, and combined with the Reynolds well No. 1 (629):

Section 1.6 Miles Southeast of Saint Albans, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (24')			
Concealed and sandstone	20	20	
Coal, Pittsburgh	4	24	24'
Conemaugh Series (601')			
Sandstone and sandy shale	36	60	
Limy shale	2	62	
Sandy shale	18	80	
Red shale	5	85	
Sandstone, massive	30	115	
Fire clay	2	117	
Red, limy shale	33	150	
Sandy shale and concealed	15	165	
Red shale	5	170	
Red and sandy shale with thin layers of sandstone	110	280	
Sandstone, massive, ferriferous, Morgantown	40	320	
Sandy shale	15	335	
Limy, red shale	5	340	
Sandstone and concealed	40	380	
Sandy shale and concealed to top of well.	45	425	
Earth and gravel	40	465	
Slate and shells	110	575	
Sand	50	625	601'
Allegheny Series (150')			
Slate	150	775	150'
Pottsville Series (1030')			
Sand, Homewood	75	850	
Slate and shells	195	1045	
Lime	25	1070	
Slate	215	1285	
Sand and slate	50	1335	
Salt sand	470	1805	1030'
Mississippian (771')			
Shale and lime, Mauch Chunk	70	1875	70'
Big lime, Greenbrier	180	2055	180'
Pocono Sandstones (521')			
Slate	20	2075	
Sand (Big Injun)	40	2115	
Slate and shells	445	2560	
Berea sand	16	2576	521'
Slate and shells, Devonian, to bottom	909	3485	909'

The above section shows the interval between the base of Pittsburgh coal and top of Berea sand to be 2552 feet, compared with 2372 feet in the Lewis section, a thickening in the Pottsville measures of 180 feet in less than 4 miles.

The following section was measured with aneroid by Teets, descending from a high summit on the Kanawha-Putnam county line, southeastward to Browns creek, and combined with the J. H Robinson well No 1 (624), 3½ miles west of Saint Albans:

Section 3½ Miles West of St. Albans, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (70′)			
Concealed	15	15	
Sandstone, massive, top portion very pebbly, Pittsburgh	55	70	70′
Conemaugh Series (565′)			
Sandy shale	25	95	
Sandstone and concealed	25	120	
Sandstone, sandy shale and concealed	48	168	
Coal blossom, Clarksburg	2	170	
Sandstone and concealed	20	190	
Red shale	10	200	
Sandstone and concealed	15	215	
Red and sandy shale	10	225	
Sandstone, massive, medium coarse, Morgantown	47	272	
Coal, Elk Lick	3	275	
Sandy shale and concealed	30	305	
Sandstone, massive (Grafton)	40	345	
Sandstone and concealed to top of J. H. Robinson well No. 1(624)	100	445	
Thence continuing with well—			
Gravel and sand	28	473	
Slate	70	543	
Red rock	7	550	
Slate	5	555	
Sand	10	565	
Slate and shells	50	615	
Sand	20	635	565′
Allegheny Series (190′)			
Slate	70	705	
Sand	90	795	
Slate	30	825	190′
Pottsville Series (960′)			
Sand, Homewood	40	865	
Slate	60	925	
Sand	85	1010	
Slate	15	1025	
Sand	60	1085	
Sand and slate	50	1135	
Black slate	20	1155	
Sand	30	1185	
Coal, (?) No. 2 Gas	5	1190	
Slate	65	1255	
Sand	20	1275	
Slate	55	1330	
Salt sand	425	1755	930′
Mississippian (758′)			
Sand and slate, Mauch Chunk	70	1825	70′
Big lime, Greenbrier	200	2025	200′
Pocono Sandstones (488′)			
Big Injun	62	2087	
Slate and shells	107	2194	
Slate	306	2500	
Sand, Berea	13	2513	488′

The above section gives the thickness of the different formations in the western part of Kanawha county. The interval between the base of the Pittsburgh sandstone and top of Berea is 2443 feet, showing that the Pottsville measures are rapidly increasing in thickness to the south.

WASHINGTON DISTRICT.—Washington district is bordered on the north by Jefferson and on the west by Jefferson district and Lincoln county, and on the south by Boone county.

The following section was obtained by Krebs with aneroid, from the summit of a high knob 3.3 miles south 28° E from St. Albans, southward to the Trowbridge well No. 1 (632), and combined with same:

Section 3.3 Miles Southeast of St. Albans, Washington District

	Thickness Feet.	Total Feet.	
Monongahela Series (46')			
Sandstone and shale	40	40	
Coal, Pittsburgh	6	46	46'
Conemaugh Series (529')			
Slate and shale	54	100	
Red shale	50	150	
Sandstone	10	160	
Red shale and sandstone	40	200	
Sandstone	30	230	
Red shale	5	235	
Sandstone and shale	25	260	
Red shale and sandstone	30	290	
Sandstone, Morgantown	30	320	
Coal blossom, Elk Lick	2	322	
Sandstone and shale	43	365	
Red shale	10	375	
Sandstone and shale to top of well	25	400	
Mud in conductor	20	420	
Sand, Buffalo and Mahoning (water 60' from top of hole; second water 140' from top of hole)	155	575	529'
Allegheny-Pottsville Series (1263')			
Coal, Upper Freeport	3	578	
Lime	22	600	
Slate	25	625	
Sand, East Lynn	150	775	
Slate	25	800	
Sand, Winifrede	80	880	
Coal, Lewiston (?)	5	885	
Sand	25	910	
Slate	140	1050	
Lime	10	1060	

	Thickness Feet.	Total Feet.	
Slate	120	1180	
Lime shells	105	1285	
Coal, No. 2 Gas (?)	3	1288	
Shells	42	1330	
Salt sand	230	1560	
Slate	40	1600	
Water sand	5	1605	
Slate	55	1660	
Sand (big water to top of hole, at 1660')	10	1670	
Slate	30	1700	
Sand, hard and close	138	1838	1263'
Mississippian (773')			
Mauch Chunk (72')			
Lime, hard	2	1840	
Gray sand, break	10	1850	
Sand, Maxton	40	1890	
Black lime	20	1910	72'
Big lime, Greenbrier	190	2100	190'
Pocono Sandstones (511')			
Slate	15	2115	
Big Injun sand	40	2155	
Slate	10	2165	
Squaw sand	10	2175	
Gray slate	404	2579	
Black slate	20	2599	
Black sand (Berea)	12	2611	511'
Black shale	20	2631	20

The above section shows the interval between the base of the Pittsburgh coal and top of Berea sand to be 2565 feet at this locality.

Another section was measured by Krebs with aneroid, descending from the top of a high knob, along road southwestward to Alum creek, ½ mile west of Bonami, Washington district:

Section ½ Mile West of Bonami, Washington District.

	Thickness Feet.	Total Feet.
Conemaugh Series (538')		
Red shale	50	50
Sandy shale and sandstone	30	80
Red and sandy shale	10	90
Sandstone, massive, Connellsville	40	130
Red and sandy shale	20	150
Sandstone, buff, Morgantown	38	188
Fire clay (Elk Lick coal horizon)	2	190
Red limy shale	40	230
Red and sandy shale	20	250
Sandstone, Grafton	70	320

	Thickness Feet.	Total Feet.	
Sandy shale	8	328	
Limestone, dark, (Ames horizon)	2	330	
Red and sandy shale	10	340	
Limy shale and fire clay	5	345	
Sandstone, massive, conglomeratic, Saltsburg	40	385	
Sandy shale	7	392	
Fire clay (Bakerstown coal horizon)	3	395	
Sandstone and concealed to 632' A. T. L.	143	538	538'

The above section begins at the base of the Monongahela series, and gives the thickness of the Conemaugh in the southwestern part of Kanawha county.

The following section was measured with aneroid by Krebs, descending a high hill southwestward to Big Coal river, at Brounland P. O.:

Section at Brounland, Washington District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (180')			
Sandstone, conglomeratic	25	25	
Sandy shale and concealed	125	150	
Sandstone, massive, conglomeratic	30	180	180'
Allegheny Series (146')			
Sandy shale and concealed	70	250	
Coal blossom (Cannel)	2	252	
Sandy shale and concealed	20	272	
Sandstone, massive, East Lynn	40	312	
Slate	1	313	
Coal, No. 5 Block (2-3')	3	316	
Sandy shale and concealed	10	326	146
Kanawha Series (234')			
Sandstone, massive, Homewood	100	426	
Sandy shale and concealed	25	451	
Sandstone, shaly	4	455	
Sandy shale, horizon of Kanawha Black Flint	13	468	
Coal, slaty ....0'— 9"			
Fire clay ....0'— 7"			
Coal, impure ....0'— 9"			
Coal, cannel ....1'— 6"	Stock-		
Coal and slate....1'— 7"	ton		
Fire clay ....0'—11"	Lewis-		
Coal, hard block....1'— 6"	ton	12	480
Slate and shale....1'— 5"			
Coal, hard ....1'— 3"			
Coal, bone ....0'— 4"			
Coal, hard (visible)..1'— 5"			
Sandy shale and concealed		10	490
Sandstone, massive, grayish 20'	Coalburg		
Sandy shale and concealed 10	sandstone	30	520
Coal, Coalburg		2'-6"	522'-6"
Sandstone and concealed to Coal river..		37'-6"	560 234'

LOUDON DISTRICT.—Loudon district is located east of Washington district and is bounded on the north by the Kanawha river.

The following section was measured by Krebs with aneroid, descending from a high knob, between Middle fork and Main Davis creek, northwestward into Middle fork of Davis creek, ½ mile south of its mouth and 3 miles south of South Charleston:

Section 3 Miles South of South Charleston, Loudon District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (280')			
Red and sandy shale	70	70	
Lime, dark, impure (Ames horizon)	2	72	
Red shale	8	80	
Sandstone, coarse, Saltsburg	50	130	
Fire clay (Bakerstown coal horizon)	2	132	
Sandstone, conglomeratic, Buffalo	25	157	
Sandy shale	13	170	
Fire clay and concealed	10	180	
Sandstone and concealed	100	280	280'
Allegheny Series (110')			
Fire clay and slate (Upper Freeport horizon)	2	282	
Sandstone	20	302	
Fire clay	2	304	
Sandstone	25	329	
Fire clay	2	331	
Sandstone and concealed, East Lynn	54	385	
Coal, (No. 5 Block)	3	388	
Slate	2	390	110'
Kanawha Series (50')			
Sandstone, massive to creek, Homewood Elev. 585' A. T. B.	50	440	50'

The following section was measured with a spirit level by Krebs, descending a hill one mile south of Hernshaw, on property of the Marmet Coal Co., where the coal has been prospected by said company:

Section 1 Mile South of Hernshaw, Loudon District.

	Thickness Feet.	Total Feet.
Allegheny Series (86'—6")		
Sandy shale and concealed	40	40
Black slate	-6"	40'-6"
Sandstone and concealed	37'-4"	77'-10"

	Thickness Feet.	Total Feet.	
Coal, impure..1'—6 " Slate . .....0'—2 " Coal, impure..1'—6 " Slate . .....1'—1½" Coal, impure..0'—2 " Slate . .....0'—3 " } No. 5 Block ..... Coal, block ...1'—9 " Slate . .....0'—1 " Coal, block ...2'—0 " Slate . .....0'—0½" Coal . .....0'—1 "	8'-8"	86'-6"	86'-6"
Kanawha Series (630'-6")			
Sandstone and concealed, Homewood sandstone	49	135'-6"	
Coal .....0'— 4" Slate ....4'— 0" } Kanawha Black Flint horizon and Black Band Iron Ore..... Coal .....0'— 5"	4'- 9"	140'3"	
Sandy shale and concealed	15'- 1"	155'-4"	
Coal .....0'— 4" Slate ....0'— 5" } Stockton ..... Coal .....2'— 4"	3'- 1"	158'-5"	
Sandstone and concealed	25	183'-5"	
Coal, probably a local split off of the Stockton	1'-10"	185'-3"	
Sandstone and concealed	55'- 3"	240'-6"	
Coal .....0'— 5" Slate ....1'—10" } Coalburg ..... Coal .....1'— 6"	3'- 9"	244'-3"	
Sandstone and concealed, Winifrede	51	295'-3"	
Coal, Winifrede, (Davis Creek Black Band)	1'-10"	297'-1"	
Sandstone and concealed	94'- 2"	391'-3"	
Coal .....1'— 0" Slate ....4'— 0" } Chilton ..... Coal .....0'— 5"	5'- 5"	396'-8"	
Sandstone and concealed	22'- 7"	419'-3"	
Coal, Thacker, block.....	2'-10"	422'-1"	
Sandstone and concealed	82'- 4"	504'-5"	
Coal	0'-11"	505'-4"	
Sandstone and concealed	31'- 8"	537'-0"	
Coal, Cedar Grove	3'- 0"	540'-0"	
Sandstone and concealed	20'- 8"	560'-8"	
Slate	0'- 8"	561'-4"	
Coal .....0'— 6" Slate ....0'— 2" } Peerless ..... Coal .....0'— 2"	0'-10"	562'-2"	
Sandstone and concealed	81'- 6"	643'-8"	
Coal, hard block..3'- 7" Slate . .....0'-10" } No. 2 Gas..... Coal blossom ....2'- 2"	6'- 7"	650'-3"	
Sandstone and concealed to creek. Elev. 700' A. T.....	66'- 9"	717'-0"	630'-6"

The section given above is very important in that it gives

intervals between the different seams in the Kanawha measures near the crest of the great Warfield Anticline.

The following section was measured by Krebs with aneroid, descending from the summit of a high hill southward into Lens creek, ¼ mile south of Marmet;

Section ¼ Mile South of Marmet, Loudon District.

Kanawha Series (736')	Thickness Feet.	Total Feet.	
Sandstone and concealed, Homewood....	95	95	
Kanawha Black Flint	5	100	
Sandstone and concealed	25	125	
Coal blossom, Stockton	5	130	
Sandstone and concealed	45	175	
Coal .....1'- 0"			
Slate and sandstone..6'- 0"			
Coal, cannel .....1'- 0"			
Slate, bituminous ....0'-10" } Coalburg ..	10	185	
Coal, bituminous ....0'-10"			
Slate, black .....0'- 4"			
Sandstone and concealed	65	250	
Fire clay, Winifrede coal blossom..	1	251	
Sandstone and concealed	64	315	
Fire clay and slate, Chilton coal horizon	5	320	
Sandstone and concealed	75	395	
Coal blossom, Thacker	2	397	
Sandstone and concealed	78	475	
Coal blossom, local	1	476	
Sandstone and concealed	34	510	
Coal blossom, Cedar Grove	3	513	
Sandstone and concealed	111	624	
Coal blossom, No. 2 Gas.....	1	625	
Sandstone, massive, Brownstown	68	693	
Coal blossom, Powellton	1	694	
Sandstone, massive	41	735	
Coal, Eagle, (Elev. 590' L.).....	1	736	736'

CHARLESTON DISTRICT.—Charleston district is near the mouth of Elk river, lying on both sides of said river, and is bounded on the north by Union, on the east by Elk and Malden districts and on the south by Loudon district.

The following section was obtained with aneroid by Krebs, in descending from a high knob, southwestward to Elk river, 1 mile above its mouth, at the pumping station of the Kanawha Water & Light Company, in the city of Charleston, combined with the Edwards well No. 1:

Section 1 Mile Northeast of Mouth of Elk River, Charleston District.

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny Series (455')			
Red and sandy shale	80	80	
Sandstone, massive (Morgantown)	60	140	
Red shale	20	160	
Sandy shale and concealed	50	210	
Fire clay	5	215	
Sandy shale	60	275	
Sandstone and concealed	100	375	
Fire clay	1	376	
Sandstone and concealed	74	450	
Slate and coal blossom (No. 5 block coal)	5	455	455'
Pottsville Series (1230')			
Sandstone, massive, to top of Edwards well, published in Vol. I A.), W. Va. Geological Survey, page 501	60	515	
Sand and gravel	28	543	
Unrecorded	12	555	
Shale	34	589	
Coal, Stockton	2	591	
Sandstone	74	665	
Shale	42	707	
Coal, Winifrede—			
Shale and sandstone	68	775	
Limestone	20	795	
Sandstone	60	855	
Shale	60	915	
Sandstone	70	985	
Coal, No. 2 Gas	...	985	
Unrecorded	20	1005	
Shale	20	1025	
Sandstone	50	1075	
Shale	30	1105	
Sandstone, salt	355	1460	
Unrecorded	55	1515	
Sandstone	170	1685	1230'
Mississippian (670')			
Mauch Chunk (80')			
Shale	10	1695	
Limestone	10	1705	
Sandstone, Maxton	60	1765	80'
Big lime, Greenbrier	200	1965	200'
Pocono Sandstones (390')			
Unrecorded	25	1990	
Sandstones, pebbly, Big Injun	40	2030	
Sandstone, red	85	2115	
Sandstone, shelly and slaty	12	2127	
Sandstone	80	2207	
Shale	148	2355	390'

Another section was measured by Teets, descending from a high knob southward along Edgewood drive to Charleston street:

PLATE VI.—Edgewood Country Club House, in Conemaugh Series, near Charleston, W. Va.

Edgewood Section, Charleston, Charleston District.

Conemaugh Series (420')	Thickness Feet.	Total Feet.	
Concealed	90	90	
Red shale	20	110	
Sandstone, massive, Morgantown	25	135	
Red shale	15	150	
Red shale and sandstone	40	190	
Sandstone, Grafton	20	210	
Red shale	9	219	
Limestone (Ames horizon)	1	220	
Red shale	18	238	
Limestone, nodular (Ames horizon)	2	240	
Red shale	27	267	
Limy shale	3	270	
Sandstone (Saltsburg)	30	300	
Sandy shale	10	310	
Sandstone, massive, Buffalo-Mahoning	80	390	
Sandy shale	10	400	
Sandstone, massive, Mahoning, to Charleston street	20	420	420'

The following section was measured with aneroid by Teets, descending from the top of a high point in the divide between Newhouse branch of Elk river, southeast down the hill along a private road to a point in Newhouse branch, at the Charleston and Elk district line, ¼ mile from mouth of Newhouse branch:

Section 2.8 Miles Northeast of Charleston, Charleston District.

Conemaugh-Allegheny Series (507')	Thickness Feet.	Total Feet.
Concealed	25	25
Red shale	10	35
Sandstone and concealed	40	75
Sandy shale	10	85
Sandstone and concealed, Morgantown	35	120
Sandy shale and concealed	50	170
Sandstone, massive, friable, conglomerate, Grafton	25	195
Red and sandy shale	10	205
Sandstone and sandy shale	30	235
Sandstone, massive, top 30' fine grained bottom 5' coarse, Saltsburg	35	270
Red shale	25	295
Sandy shale	5	300
Red shale	10	310
Sandstone and concealed, Buffalo-Mahoning	70	380
Sandy shale	15	395

	Thickness Feet.	Total Feet.	
Sandstone, massive, coarse	50	445	
Sandy shale	5	450	
Sandstone, East Lynn	35	485	
Sandy shale	20	505	
Coal, No. 5 Block	2	507	507'
Sandstone, Homewood, (Elev. 625' A. T. B.)	13	520	13'

Another section was taken by Krebs, descending southward from a high knob between Ruffner and Wilson branches to Wilson branch, which gives the following results:

Section Taken in Eastern Limits of Charleston, Charleston District.

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny Series (277')			
Red limy shale	10	10	
Sandy shale	3	13	
Sandstone, friable	20	33	
Fire clay	2	35	
Sandstone	28	63	
Fire clay	2	65	
Sandstone and concealed	28	93	
Fire clay	2	95	
Sandstone	88	183	
Coal blossom	2	185	
Sandstone, massive	90	275	
Coal blossom, No. 5 block	2	277	277'
Kanawha Series (196')			
Sandstone, Homewood	61	338	
Kanawha flint	4	342	
Sandy shale	4	346	
Coal ..... 1'-0"			
Slate ..... 0'-5"			
Coal, impure.. 3'-0" — Stockton-Lewiston	6	352	
Slate, shaly.. 0'-1"			
Slate, dark... 1'-1"			
Coal, impure.. 0'-5"			
Sandstone and concealed	108	460	
Coal blossom, Winifrede	3	463	
Concealed to level of K. & M. Ry.	10	473	196'

CABIN CREEK DISTRICT.—Cabin Creek district is situated east of Loudon and Malden districts, and south of Malden and Elk districts, and is bounded on the east by Fayette county, and on the south by Fayette, Raleigh and Boone counties, and is located in the southern part of Kanawha county.

The following section was obtained by Krebs in measuring a section from the top of a high knob, between Lens creek

and Field creek, and combining the results with the core drill hole sunk by the Winifrede Coal Company at Winifrede P. O.:

Section at Winifrede P. O., Cabin Creek District.

	Thickness Feet.	Total Feet.	
Sandy shale and concealed, **Conemaugh**..	115	115	115′
Allegheny Series (152′)			
Fire clay	2	117	
Sandy shale and sandstone	28	145	
Sandstone, conglomeratic, East Lynn....	60	205	
Sandy shale and concealed	40	245	
Sandstone, massive	20	265	
Coal blossom, No. 5 Block	2	267	152′
Pottsville (1985′)			
Sandy shale and concealed, Homewood..	98	365	
Coal blossom, Stockton	5	370	
Sandstone, fine grained, Coalburg	75	445	
Coal blossom, Coalburg	5	450	
Sandstone, massive	55	505	
Coal blossom	2	507	
Sandstone, Winifrede	27	534	
Coal .....2′-6″ ⎫ **Slate** ..1′-0″ ⎬ **Winifrede**	6	540	
Coal .....2′-6″ ⎭			
Sandstone and concealed	66	606	
Coal blossom, Chilton	2	608	
Sandstone and concealed to top of Winifrede core drill hole	132	740	
Bowlders and sand	15	755	
Blue shale	1	756	
Coal, shaly	1	757	
Shale, blue	5	762	
Sandstone and shale	1	763	
Shale, dark, with bands of sandstone....	12 3″	775 3″	
Coal	... 10″	776 1″	
Shale, soft	1 11″	778	
Shale, dark, sandy	8	786	
Shale, sandy	5 6″	791 6″	
Shale, dark, sandy	4 2″	795 8″	
Coal, Peerless	1 2″	796 10″	
Fire clay	1 8″	798 6″	
Sandstone	2 2″	800 8″	
Sandy shale	3 3″	803 11″	
Shale, dark	1 1″	805	
Shale, dark	... 5″	805 5″	
Coal	... 10″	806 3″	
Sandstone, dark	... 9″	807	
Shale, sandy	2	809	
Shale, dark with bands of sandstone....	12 8″	821 8″	
Coal, No. 2 Gas	2 8″	824 4″	
Fire clay	... 3″	824 7″	
Shale, coal partings	2 5″	827	
Shale, sandy	4	831	

		Thickness Feet.		Total Feet.	
Sandstone		2		833	
Shale, dark		8		841	
Shale, white		2		843	
Shale		...	6″	843	6″
Coal		...	8″	844	2″
Shale		2	10″	847	0″
Sandstone		10	6″	857	6″
Sandstone, hard		2	6″	860	0″
Sandstone		50	3″	910	3″
Coal		0	2″	910	5″
Sandstone		6	0″	916	5″
Sandy shale		1	5″	917	10″
Shale, soft, sandy		0	8″	918	6″
Coal		0	4″	918	10″
Shale, soft		4	2″	923	0″
Shale, sandy		2	1″	925	1″
Shale		0	6″	925	7″
Coal, Eagle		1	2″	926	9″
Shale		0	3″	927	0″
Shale, dark		2	0″	929	0″
Sandstone		10	0″	939	0″
Shale, dark		5	5″	944	5″
Coal, Little Eagle		0	6″	944	11″
Shale, light		2	0″	946	11″
Shale, sandy		6	10″	953	9″
Coal		0	10″	954	7″
Shale, sandy		4	5″	959	0″
Sandstone		13	0″	972	0″
Sandstone, hard		9	9″	981	9″
Sandstone		13	3″	995	0″
Shale, blue, hard bands		14	0″	1009	0″
Shale, hard bands		9	2″	1018	2″
Shale, sandy		8	5″	1026	7″
Sandstone, with shale partings		4	5″	1031	0″
Sandstone 8′-4″ Shale, hard 3′-8″ Sandstone, hard with harder bands 12′-0″ Sandstone, hard 2′-8″ Sandstone with shale partings 4′-4″ Sandstone, hard, white... 8′-5″ Sandstone, hard, conglomeratic 2′-6″ Sandstone 2′-0″ Conglomerate 1′-4″ Sandstone, white, hard.. 1′-9″ Sandstone 12′-0″	Nuttall	59		1090	0″

Thence continuing with well No. 1, put down in North Hollow S 26¼° E. 1.6 mile, from core-drill hole, and using the base of the Winifrede coal as a common basis in both sections.

	Thickness Feet.		Total Feet.			
Sand with salt water	632′	0″	1722′	0″		
Sand	235′	0″	1957′	0″		
Slate	15′	0″	1972′	0″		
Sand	105′	0″	2077′	0″		
Lime	15′	0″	2192′	0″		
Sand to base of Pottsville	160′	0″	2252′	0″	1985′	0″
Mauch Chunk (110′)						
Slate	10′	0″	2262			
Slate, red	15′	0″	2277			
Slate, black	5′	0″	2282			
Slate	10′	0″	2292			
Red rock and shale	70′	0″	2362		110′	0″
Big lime, Greenbrier to bottom	140′	0″	2502		140′	0″

This section begins about 500 feet below the base of the Pittsburgh coal horizon, and ends about 560 feet above the top of the Berea sand, which would make the interval between the base of the Pittsburgh sandstone and top of Berea at that place to be 3,562 feet.

The following section was measured with aneroid by Krebs, descending westerly from a high hill to Seng creek at Highcoal, Sherman district, Boone county, 1 mile south of the Kanawha-Boone county line:

Section at Highcoal, Sherman District, Boone County.

	Thickness Feet.		Total Feet.			
Allegheny Series (99′)						
Sandy shale	40		40			
Sandstone, massive, East Lynn	50		90			
Slate	1		91			
Coal, hard, block. 6′-9″ Slate 0′-1″ Coal, hard, block. 1′-2″ — No. 5 Block	8		99		99′	
Kanawha Series (878′-6″)						
Sandstone and concealed, Homewood	156		255			
Slate	0′	4″	255′	4″		
Coal, block. 2′-8″ Slate 1′-2″ Coal, block. 2′-4″ — Stockton-Lewiston	6′	2″	261′	6″		
Slate	1′	6″	263′	0″		
Sandstone, top portion massive, Coalburg	97′	0″	370′	0″		
Coal, Coalburg	2′	11″	372′	11″		
Slate	1′	1″	374′	0″		
Sandstone and concealed, Winifrede	157′	0″	531			
Coal, Winifrede, "Dorothy," etc.	8′	0″	529			
Sandstone and concealed	90′	0″	619			
Coal blossom, Chilton	1′	0″	620			

	Thickness Feet.		Total Feet.			
Sandstone and concealed	135′	0″	755			
Coal blossom, Thacker ?.....	1′	0″	756			
Sandstone and concealed	104′	0″	860			
Coal blossom	1′	0″	861			
Sandstone and concealed	112′	0″	973			
Coal blossom, No. 2 gas.....	4′	6″	977′	6″	878′	6″

The Winifrede coal is mined by the Anchor Coal Company at Highcoal, and the interval to the **No. 2 Gas Bed** was obtained from a well sunk at the power house, at the base of the section.

The following section was measured with aneroid by Krebs, descending from top of a high hill between Schuyler Fork and Morris creek in Fayette county to Donwood P. O., Kanawha county.

Section at Donwood P. O., Cabin Creek District.

	Thickness Feet.		Total Feet.			
Conemaugh-Allegheny Series (317′)						
Sandy shale and concealed	50		50			
Sandstone, massive	95		145			
Sandy shale and concealed.....	25		170			
Sandstone, massive, conglomeratic, East Lynn	140		310			
Coal, No. 5 Block	7		317		317′	
Kanawha Series (758′)						
Sandstone and concealed, Homewood	65		382			
Kanawha Black Flint	6		388			
Concealed and massive, sandstone, Coalburg	130		518			
Coal blossom, Coalburg.....	...		...			
Sandstone, massive and concealed to bench	45		563			
Sandstone, mostly massive, Winifrede	90		653			
Slate	0′	8″	653′	8″		
Coal, splint....2′9″ Slate, gray ....0′-2″ Coal, splint ...0′-4″ Sandstone, hard, black .. ..0′-4″ Coal, splint ...1′-9″ } Winifrede	5′	4″	659			
Sandstone and concealed	50		709			
Coal blossom, Chilton	...		...			
Sandstone, massive and concealed	200		909			
Coal, Cedar Grove	3		912			
Massive sandstone, shales, etc.....	140		1052			
Coal, slaty, Peerless	2′	6″	1054′	6″		
Shales, sandy	15		1069′	6″		
Coal, No. 2 gas.....	5′	6″	1075′	0″	758′	0″

The above section shows all the important coals in the Kanawha series, except the Thacker.

The interval between the base of the Kanawha Black Flint and the top of the No. 2 Gas coal is 681 feet at this point.

The No. 5 Block, the Winifrede, and the No. 2 Gas are being mined on Morris creek, near where this section was taken.

This and the previous section render it practically certain that the thick coal bed at Dorothy, Raleigh county, which is known as the Dorothy seam is the **Winifrede bed** instead of the **Coalburg** with which at one time it was thought possible it might be identical (I. C. W.).

The following section was measured by aneroid by Teets, descending from a high point one mile east of Mammoth P. O., northwest to Hurricane Fork of Kelly creek, one mile east of Mammoth P. O.:

Section One Mile East of Mammoth P. O., Cabin Creek District

		Thickness Feet.	Total Feet.	
Allegheny Series (205')				
Sandstone and concealed		200	200	
Coal (Abandoned opening, No. 5 Block reported)		5	205	205'
Kanawha Series (485')				
Sandstone and concealed. Homewood		180	385	
Kanawha Black Flint		7	392	
Sandstone and sandy shale.....		48	44b	
Slate, gray		0' 8"	440' 8"	
Coal .....1'-1"				
Coal, bone....0'-2"				
Coal .....2'-8"				
Slate, gray ...0'-4"				
Coal .....0'-9"	Stockton-Lewiston ...	7' 4"	448' 0"	
Slate, black..0'-2"				
Coal .....0'-8"				
Slate, gray ..0'-3"				
Coal, hard block (Vis.).1'-3"				
Concealed		32' 0"	480' 0"	
Sandstone, massive		25' 0"	505' 0"	
Slate, gray		1' 2"	506' 2"	
Coal, medium hard.1'-11"				
Coal, bone .....0'- 3"				
Coal .....1'- 5"				
Nigger head .....0'- 4"	Coalburg.	10' 10"	517' 0"	
Coal, block .....3'- 1"				
Fire clay .....3'- 2"				
Coal (Vis.) .....0'- 8"				

	Thickness Feet.	Total Feet.	
Sandstone and concealed	38	555	
Sandstone	5	560	
Shale	4	564	
Sandstone	2	566	
Coal .....1'-1" / Slate .....0'-4" / Coal .....1'-2" — Winifrede	2' 7"	568' 7"	
Slate	2' 5"	571	
Sandstone, massive	29	600	
Concealed to bed of Hurricane fork of Kelly creek, (Elev. 860' A. T. B.)	90	690	485'

The following section was obtained by combining a section published in Volume II, W. Va. Geol. Survey, page 518, with the Watson Well No. 1 at Shrewsbury, Cabin Creek district. The levels of several of the coal beds were verified by the writer:

Shrewsbury Section, Malden District.

	Thickness Feet.	Total Feet.	
Allegheny Series (175')			
Sandstone, top of river bluff.....	33' 6"	33' 6"	
Slate	12' 0"	45' 6"	
Sandstone, conglomeratic	11' 0"	56' 6"	
Coal .....0'-8" / Slate .....2'-0" / Coal .....2'-0" / Nigger head..0'-4" / Coal .....4'-6" / Soapstone ...3'-0" / Coal .....4'-6" — North Coalburg (No. 5 Block)	17' 0"	73' 6"	
Limestone nodules	1' 6"	75' 0"	
Sandstone .....39'-0" / Sandstone, rotten...17'-6" / Sandstone, coarse, white .....37'-6" / Sandstone, red ..... 3'-0"	97' 0"	172' 0"	
Fire clay	1' 0"	173' 0"	
Coal, Clarion	2' 0"	175' 0"	175'
Kanawha Series (1639')			
Sandstone, coarse, Homewood.....	64' 8"	239' 8"	
Iron nodules	1' 6"	241' 2"	
Kanawha Black Flint	7' 0"	248' 2"	
Sandstone, hard	13' 6"	261' 8"	
Coal .....2'-6" / Sandstone, white 4'-5" / Coal .....4'-6" — Stockton-Lewiston	11' 5"	273' 1"	
Slate	2' 6"	275' 7"	
Sandstone, Coalburg	32' 4"	307' 11"	

	Thickness Feet.	Total Feet.	
Coal, Coalburg	4′ 0″	311′ 11″	
Slate	8′ 0″	319′ 11″	
Coal (coal blossom)	2′ 0″	321′ 11″	
Sandstone, massive (Winifrede)	76′ 6″	398′ 5″	
Coal, slate and iron ore, mixed, Winifrede	5′ 0″	403′ 5″	
Slate	2′ 0″	405′ 5″	
Sandstone	44′ 5″	449′ 10″	
Slate with iron ore nodules	23′ 9″	473′ 7″	
Coal blossom, Chilton	2′ 0″	475′ 7″	
Sandstone	59′ 9″	535′ 4″	
Slate	3′ 6″	538′ 10″	
Iron ore	1′ 0″	539′ 10″	
Coal blossom, Thacker (?) Block	1′ 0″	540′ 10″	
Sandstone	71′ 4″	612′ 2″	
Slate	11′ 4″	623′ 6″	
Coal, Cedar Grove	2′ 8″	626′ 2″	
Fire clay	5′ 0″	631′ 2″	
Sandstone, friable	42′ 9″	673′ 11″	
Coal	1′ 0″	674′ 11″	
Sandstone	25′ 6″	700′ 5″	
Coal, Peerless	3′ 0″	703′ 5″	
Top of Watson well No. 1(694) Conductor	13′ 7″	717′ 0″	
Lime formation (slate)	177′ 0″	894′ 0″	
Coal, Eagle	5′ 0″	899′ 0″	
Lime formation (slate)	95′ 0″	994′ 0″	
Sand	110′ 0″	1104′ 0″	
White slate	5′ 0″	1109′ 0″	
Lime formation (slate)	115′ 0″	1224′ 0″	
Sand	150′ 0″	1374′ 0″	
Brown slate	95′ 0″	1469′ 0″	
Sand	10′ 0″	1479′ 0″	
Brown slate	25′ 0″	1504′ 0″	
Sand	140′ 0″	1644′ 0″	
White lime	25′ 0″	1669′ 0″	
Soft slate	19′ 0″	1688′ 0″	
Lime	88′ 0″	1776′ 0″	
Sand, base of Pottsville	38′ 0″	1814′ 0″	1639′
Mauch Chunk (265′)			
Slate	18′ 0″	1832′ 0″	
Red rock	25′ 0″	1857′ 0″	
Soft brown slate	12′ 0″	1869′ 0″	
Sand, Maxton	120′ 0″	1989′ 0″	
Lime, blue	12′ 0″	2001′ 0″	
Slate	9′ 0″	2010′ 0″	
Little lime	12′ 0″	2022′ 0″	
Pencil cave	12′ 0″	2034′ 0″	
Slate and shell	45′ 0″	2079′ 0″	265′
Big lime, Greenbrier	225′ 0″	2304′ 0″	225′
Pocono Sandstones (238′)			
Red rock	50′ 0″	2354′ 0″	
Slate and shell	35′ 0″	2389′ 0″	
Sand (Big Injun) ?	153′ 0″	2542′ 0″	238′

In the foregoing section the writer has made some changes from that as originally correlated by Mr. C C. Lewis, and given names to several coals. In the section given by Mr. Lewis there is a 3′ seam of coal at 15′ 6″ below the Peerless and there the No. 2 gas seam is 4′ 6″ thick 15 feet below the first seam, or upper portion of the No. 2 gas seam. The section shows that the Pottsville series has attained a thickness of 1639 feet.

Summary.

The following table gives not only the thickness of the Carboniferous, Mississippian and Devonian as exhibited by the foregoing general sections; but it also gives in most cases the thickness of the several series under each. The sections are arranged alphabetically with reference to the nearest town or postoffice.

PLACE MEASURED	CARBONIFEROUS						MISSISSIPPIAN			
	Dunkard	Monongahela	Conemaugh	Allegheny	Pottsville	Total	Mauch Chunk	Greenbrier Limestone	Pocono	Total
Apgah	....	....	205	155	90	445	....	....	....	....
Barlow	....	104	263	....	....	367	....	....	....	....
Bonami	....	....	538	....	....	538	....	....	....	....
Bream	....	....	501	29	....	530	....	....	....	....
Blundon	....	187	207	....	....	394	....	....	....	....
Brounland	....	....	180	146	224	550	....	....	....	....
Clendenin	....	60	....	....	1030	1785	178	138	27	343
Charleston	....	....	....	....	1430	1685	80	200	390	670
Dana	....	....	233	110	1385	1728	48	239	802.5	1089.5
Donwood	....	....	....	....	714	1025	....	....	....	....
Goldtown	217	309	498	255	295	1574	210	105	544	859
Guthrie	....	171	402	....	....	573	....	....	....	....
Highcoal	....	....	....	99	854	953	....	....	....	....
Hernshaw	....	....	....	86.5	673.5	760	....	....	....	....
Keeferton	....	....	....	....	2165	2165	40	....	....	40
Lewis	....	55	590	115	885	1645	90	205	510	805
Mammoth	....	....	....	205	485	690	....	....	....	....
Marmet	....	....	....	....	736	736	....	....	....	....
Powellton	....	....	....	165	....	2300	825	156	839	1820
Putney	....	....	270	140	140	550	....	....	....	....
Rocky Fork	....	100	595	190	930	1715	95	185	495	780
Shrewsbury	....	....	....	75	1757	1832	247	225	238	710
Sissonville	135	291	535	....	....	1982	....	145	527	672
South Charleston	....	....	280	110	50	440	....	....	....	....
Saint Albans	....	70	565	160	960	1755	70	200	488	758
Saint Albans	....	24	601	225	955	1805	75	180	521	871
Walgrove	....	100	....	....	....	1747	200	140	118	458
Wallace	....	96	....	....	....	1707	153	170	470	793
Winifrede	....	....	115	142	1895	2162	110	140	....	250

CHAPTER V.

STRATIGRAPHY—THE DUNKARD SERIES.

The Dunkard series or Permo-Carboniferous rocks constitute the highest beds of the Appalachian area of North America, and the most recent in formation within the Kanawha county area, with the exception of the alluvium deposits along the river bottoms and large streams. For a general description of this series see Vol. II, W. Va. Geol. Survey, page 110.

For a general section of the Dunkard series for West Virginia as compiled by Mr. Ray V. Hennen, Assistant Geologist, from a large number of detailed sections, see the Doddridge-Harrison county report, pages 134-135, 1912.

The Dunkard series of rocks covers a small part of Kanawha county, capping the hills in Union and Poca districts in the northern part of the county. The extent of this group of rocks in the area under discussion is graphically shown on the General and Economic Geology map accompanying this report.

The Dunkard series consists of sandstones, sandy shales, limy shales, and red shales, and one or two thin beds of coal. The maximum thickness of these measures left uneroded (325 feet) occurs in the northwest corner of Union district.

DUNKARD SERIES.

Sections.

Several sections of the Dunkard series will now be presented in addition to those already given.

The following section was measured by Krebs with aneroid, descending northward along road into Dry fork of Kellys creek.

Section Two Miles Southeast of Heizer P. O., Union District.

	Thickness Feet.	Total Feet.	
Dunkard Series (145')			
Red shale	40	40	
Sandstone, Mannington	30	70	
Red shale	30	100	
Sandstone, massive, Waynesburg	45	145	145'
Monongahela Series (265')			
Fire clay, Waynesburg coal horizon	2	147	
Red shale	23	170	
Sandstone, Gilboy	20	190	
Red shale	10	200	
Sandstone, massive, Uniontown	38	238	
Red and sandy shale	17	255	
Sandstone, Arnoldsburg	15	270	
Red shale	4	274	
Sandstone	14	288	
Sandy shale	12	300	
Red shale	10	310	
Sandstone, Sewickley	50	360	
Red shale	4	364	
Sandstone, Pittsburgh	46	410	265'
Pittsburgh coal horizon, (Elev. 655' A. T. B.)	...	...	

The base of the section ends with the Pittsburgh coal, giving the thickness of the Monongahela series 265 feet, and that of the Dunkard as 145 feet.

Another section was measured with aneroid by Krebs from top of high knob in the Kanawha-Putnam county line, descending along road eastward to Frog creek, 2.5 miles southeast of Liberty.

Section 2.5 Miles Southeast of Liberty, Union District.

	Thickness Feet.	Total Feet.	
Dunkard Series (315')			
Sandy shale	30	30	
Sandstone, Upper Marietta	30	60	
Sandy shale	40	100	
Red shale	10	110	
Sandstone, gray, Lower Marietta	27	137	
Fire clay, Washington coal horizon	3	140	
Red shale, limestone nodules	16	156	
Sandstone	4	160	
Red shale	24	184	
Sandstone, Mannington	35	219	
Red shale	30	249	
Sandstone, hard	9	258	
Red shale	14	272	
Sandstone, Waynesburg	43	315	315'

	Thickness Feet.	Total Feet.	
Monongahela Series (40')			
Red shale	1	316	
Fire clay, Waynesburg coal	2	318	
Red shale	32	350	
Sandstone, Gilboy	5	355	40'

The above section begins at the base of the Hundred sandstone and gives possibly the greatest thickness of the Dunkard series to be found anywhere in Kanawha county.

The following section was measured by Krebs with aneroid, descending eastward along road into Second creek, three miles northwest of Sissonville, Poca district:

Section 3 Miles Northwest of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (173')			
Sandstone (Lower Marietta)	25	25	
Red shale with limestone nodules	30	55	
Sandstone, friable coarse, Mannington	34	89	
Red and sandy shale	36	125	
Sandstone, massive, coarse, Waynesburg.	48	173	173'
Monongahela Series (72')			
Fire clay, Waynesburg coal horizon	2	175	
Sandy shale	27	202	
Sandstone, Gilboy	38	240	
Red shale	5	245	72'

The above section gives the interval from the base of the Lower Marietta sandstone to base of the Waynesburg sandstone as 148 feet.

Another section was measured by the writer, with aneroid, descending along road westward into Allen Fork of Middle Fork of Poca river, 5.5 miles northwest of Sissonville, Poca district, as follows:

Section 5.5 Miles Northwest of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (205')			
Sandstone, medium coarse, Lower Marietta	40	40	
Sandy shale	10	50	
Red shale	25	75	
Sandstone and concealed, Mannington	45	120	
Red shale	23	143	
Sandstone, massive, Waynesburg	62	205	205'
Monongahela Series (85')			
Red and sandy shale	25	230	
Sandstone, Gilboy	41	271	
Concealed	4	275	
Sandy shale and concealed	15	290	85'

The following section was measured with aneroid by Krebs, descending from a high hill eastward into Allen Fork of Middle Fork of Poca river at mouth of Cavelick run, 4 miles northwest of Sissonville, Poca district:

Section 4 Miles Northwest of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (80')			
Sandy shale	15	15	
Sandstone, massive, Waynesburg	65	80	80'
Monongahela Series (187')			
Red and sandy shale	35	115	
Sandstone (Gilboy)	47	162	
Sandy shale and concealed	23	185	
Sandstone, massive	50	235	
Concealed	30	265	
Coal blossom, Sewickley	2	267	187'

The above section is interesting in that it gives the interval between the base of the Waynesburg sandstone and the Sewickley coal as 187 feet.

DESCRIPTION OF THE DUNKARD FORMATION.

The several formations of the Dunkard series which occur in the area under discussion in this volume will now be described in detail. A description of the upper formations, or the formations absent from the area, has already been given in Survey reports previously published, to which the reader is referred.

The Hundred Sandstone.

This sandstone received its name from Hundred, a small village in eastern Wetzel county, where it occurs in massive cliffs and has been quarried for building purposes.

The sandstone crops in the highest hills just north of the Kanawha-Jackson line, where it occurs in cliffs from 20 to 30 feet high. The writer did not observe this sandstone in the Kanawha County Area.

The Upper Marietta Sandstone.

The interval between the Hundred sandstone and the Washington coal in the northern part of the State is nearly al-

ways occupied by two great sandstone ledges which were named in the early reports the Upper and Lower Marietta sandstones, from their occurrence near Marietta, Ohio, where they with the Hundred sandstone are quarried for building stone and for grindstones. The Upper Marietta sandstone caps the highest knobs in the northern part of Kanawha county, being massive and 20 to 30 feet thick.

The Creston Red Shale.

In Jackson, Mason and part of Putnam counties 20 to 40 feet of dark red limy shales separate the Upper and Lower Marietta sandstones. These shales have been designated by Mr. Ray V. Hennen as the **Creston Reds,** owing to their fine development on the Creston Flats, one mile east from Creston, Wirt county. In Kanawha county, these occur in the northern part of Poca and Union districts and are from 20 to 30 feet thick. The limestone nodules which usually occur in the shales are more or less displaced by sandy shale, and the soil formed is light red instead of deep red and marly.

The Lower Marietta Sandstone.

This sandstone occurs in a limited area in the northern part of Union and Poca districts, and measures from 25 to 30 feet in thickness, being buff, fine grained, and the top portion is often flaggy. No quarries in it were observed.

The Washington Coal.

The Washington coal horizon occurs just underneath the Lower Marietta sandstone. This coal is a multiple bedded seam with pure coal only in its basal portion in the northern part of the State. It is a very persistent bed and can be traced from southwestern Pennsylvania through the entire western portion of West Virginia, as far south as the northern part of Cabell county.

No opening was found in Kanawha county where a section could be measured but a **coal blossom** at this horizon was observed at several places in the northern part of Union and Poca districts.

An opening on the waters of Eighteen Mile creek, two miles east of Extra, Union district, Putnam county, and four miles northwest of the Kanawha-Putnam county line, on land of Wm. Bowles shows the following section:

Section of Wm. Bowles Coal Opening.

		Thickness Feet.	Total Feet.
Sandstone, Lower Marietta		20	20
Black slate		3	23
Slate and coal, alternating..0'-10"			
Slate ....0'-22"			
Coal, good ....1'- 0"	Washington	3	26
Slate ....0'- 2"			
Coal, good ....0'-10"			
Fire clay floor.			

The Washington coal has been mined on the hills just east of Goldtown, Jackson county, and east of the Kanawha-Jackson county line, where it shows practically the same section as in the Bowles opening.

Washington Fireclay Shales.

Occurring just underneath the Washington coal is a dark greenish yellow shale and impure fireclay, that has been designated the **Washington Fireclay Shale** by Ray V. Hennen in the detailed county report of Wirt, Roane and Calhoun counties. In the Kanawha county area, traces of this shale 2 to 3 feet thick and having a greenish yellow cast, were observed in Union and Poca districts from 2 to 3 feet thick.

The Washington Sandstone.

The Washington sandstone, which often occurs in the northern part of the State, is absent in the Kanawha county area.

The Little Washington Coal.

The Little Washington coal of southeastern Pennsylvania and northeastern West Virginia does not appear to be present in the area under discussion in this volume.

The Mannington Sandstone.

At from 15 to 25 feet underneath the Washington coal, in several of the southwestern counties of West Virginia, there occurs a great coarse, gray and buff, massive sandstone, frequently pebbly, ranging in thickness from 20 to 50 feet, that has been named by G. P. Grimsley the **Mannington sandstone,** from the town of the same name in Marion county, W. Va., where it has been quarried for building purposes.

In the Kanawha county area, this sandstone is buffish gray and about 30 feet in thickness in the northern part of Union and Poca districts where it occurs.

The Waynesburg "A" Coal.

The Waynesburg "A" coal, which occurs from 75 to 90 feet above the Waynesburg bed, appears to be absent in the Kanawha county area.

The Waynesburg Sandstone.

At from 40 to 60 feet below the Washington coal and from 1 to 10 feet above the base of the Dunkard series there occurs in Kanawha county a great massive sandstone that has been called the **Waynesburg sandstone.** Dr. I. C. White gives a description of this formation in Bulletin No. 65 of the U. S. Geological Survey, page 245.

Since the publication of Bulletin No. 65 in 1891, a more detailed study of the sandstones of the Dunkard series in West Virginia as published in the detailed county reports reveals the fact that the Lower Marietta and the Mannington sandstone as well as the Waynesburg are frequently quite conglomeratic in Wirt, Roane, Calhoun and Jackson counties.

In the Kanawha county area, the crop of the Waynesburg sandstone is shown very closely by the boundary line between the Dunkard and Monongahela series as outlined on the General and Economic Geology map accompanying this report. This shows that the Dunkard series covers only a small area in the northern part of the county.

The Waynesburg sandstone is massive, buff and pebbly

where it caps the highest hills and forms abrupt bluffs in which the rock is 40 to 60 feet thick. Just north of Sissonville it caps the highest knobs, on the north of Pocatalico river. The sandstone goes under the Middle Fork of Pocatalico just south of Goldtown, Jackson county.

The Cassville Plant Shale.

The first and lowest member of the Dunkard series is the Cassville Plant shale, which was so named by White and Fontaine from a town of that name in Monongalia county, West Virginia, where it crops. There it ranges in thickness from 0 to 20 feet and is rich in fossil insect remains as well as in fossil plants.

In the Kanawha county area it is not well defined nor easily recognized, since the Waynesburg coal bed is nearly always absent or covered deeply with debris and not exposed.

Age of the Dunkard Series.

There has been much discussion both by American and European geologists as to the age of the Dunkard series as revealed by the fossil fauna and flora. On pages 69-77 of the Ohio-Brooke-Hancock Report of the W. Va. Geol. Survey, G. P. Grimsley gives a very interesting account as to the age of the Dunkard rocks as discussed by geologists in other publications. From all the fossil plant evidence yet collected, Dr. David White, the distinguished paleobotanist of the U. S. G. Survey, and Chief Geologist of the same, concludes that this series apparently belongs to the lower Permian of Europe.

CHAPTER VI.

THE MONONGAHELA SERIES.

The series of rocks embraced between the bottom of the Pittsburgh coal and the base of the Cassville Plant shale or to the top of the Waynesburg coal, has been named the Monongahela series by H. D. Rogers from the river of that name in Pennsylvania, along which its coal beds were first studied.

In West Virginia the thickness of this series of rocks ranges from 260 feet along the Ohio river to over 430 feet in Marion county. The limestones that occur in this series in southwestern Pennsylvania and the border counties of West Virginia are displaced by sandy shale and sandstone in southern West Virginia.

Dr. I. C. White gives an interesting description of this series in Volume II, West Virginia Geological Survey, pages 124-125 to which the reader is referred for a more detailed description of these beds in other portions of the State.

Several sections of the Monongahela series have been given in Chaper IV of this report on preceding pages as indicated in the table summarizing the sections at the end of that chapter. In addition a few more scattered sections of these measures will now be presented.

The following section was measured by Krebs with aneroid, descending northwestward to Fisher branch of Rocky fork of Poca river, one mile southeast of Morning Star school, Union district:

Section 1 Mile Southeast of Morning Star School, Union District.

	Thickness Feet.	Total Feet.
Monongahela Series (255')		
Sandy shale and concealed	50	50
Red limy shale	40	90
Sandstone, friable, Uniontown	50	140

	Thickness Feet.	Total Feet.	
Sandy shale	5	145	
Red shale	5	150	
Sandstone, coarse, Sewickley	27	177	
Red and sandy shale	5	182	
Sandstone, coarse, Pittsburgh	70	252	
Coal blossom, Pittsburgh	3	255	255'
Conemaugh Series (215')			
Sandy shale and concealed	170	425	
Sandstone, massive, Morgantown	40	465	
Sandy shale and concealed	3	468	
Limestone, impure, Elk Lick	2	470	215'

The section begins at the base of the Dunkard series and gives the thickness of the Monongahela series as 255 feet, to which by adding a correction of 15 feet for dip, gives the total thickness 270 feet.

Another section was measured by Krebs with aneroid, descending southward from the top of a high knob into Higginbotham branch one mile north of Emma Bell School:

Section 1 Mile North of Emma Bell School, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (135')			
Sandy shale and concealed	65	65	
Sandstone, massive, conglomeratic, Waynesburg	70	135	135'
Monongahela Series (262')			
Red and sandy shale	40	175	
Sandstone and concealed, Gilboy	30	205	
Red and sandy shale	25	230	
Sandstone and sandy shale	25	255	
Dark red shale	30	285	
Sandstone and sandy shale	10	295	
Red and sandy shale	10	305	
Sandstone, Sewickley	30	335	
Red and sandy shale	10	345	
Sandstone, massive..23' Blue shale ..... 2' Sandstone, massive.. 7' Blue shale ..... 3' Sandstone, massive..11' Sandy shale ..... 4'	Pittsburgh .. 50	395	
Coal blossom, Pittsburgh	2	397	262'

The above section gives the thickness of the Monongahela series 262 feet.

The following section was measured by Teets with aneroid from a point 2.3 miles west of Sissonville at head of First

creek, westward to the head of a branch of Derrick creek, ½ mile below or south of the fork of Derrick creek.

Section 2.3 Miles West of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (70')			
Concealed	35	35	
Red shale	5	40	
Sandstone and concealed, Waynesburg	30	70	70'
Monongahela Series (220')			
Concealed	20	90	
Red shale	35	125	
Fire clay	2	127	
Sandstone, massive, and sandy shale	38	165	
Sandy shale	15	180	
Sandstone	5	185	
Red shale	20	205	
Sandstone	10	215	
Red shale	3	218	
Limestone	2	220	
Sandstone, massive, fine grained, Sewickley	40	260	
Coal blossom, Sewickley	1	261	
Sandy shale	9	270	
Sandstone, massive, Pittsburgh. (Elev. 695' A. T. B.)	20	290	220'

This section ends about 50 feet above the base of the **Pittsburgh Coal**, which interval added would make the Monongahela series 270 feet thick at this locality.

Another section was measured by Krebs, descending from the summit of Gunstock Knob, northward to Hunt Fork of Green creek of Pocatalico river as follows:

Section 2 Miles South of Kettle, Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (80')			
Sandy shale	30	30	
Sandstone, Waynesburg	50	80	80'
Monongahela Series (265')			
Sandy shale	5	85	
Red shale	15	100	
Sandstone, Gilboy	30	130	
Red shale	20	150	
Sandstone, Uniontown	25	175	
Red shale	25	200	
Sandstone, Arnoldsburg	30	230	
Sandy shale	25	255	

PLATE VII(a).—Scene on Poca river west of Sissonville, showing Monongahela Series.

PLATE VII(b).—Scene on Poca river west of Sissonville, showing Monongahela Series.

		Thickness Feet.	Total Feet.	
Sandstone, friable ..... 7' Sandstone, massive ...78'	Pittsburgh..	85	340	265'
Fire clay (Pittsburgh coal horizon).....		5	345	
Conemaugh Series (143')				
Sandy shale and concealed		5	350	
Sandstone, Lower Pittsburgh		60	410	
Sandy shale		23	433	
Sandstone, massive, Connellsville, to bed of Hunt Fork, 797' A. T. L.....		55	488	143'

Adding a correction of 25 feet for the dip to the 265 feet gives the Monongahela rocks a total thickness of 290 feet.

The following section was measured by Krebs with aneroid from a high hill near the Kanawha-Roane county line southward to Rucker Fork of Little Sandy creek, 3 miles northeast of Hunt, Elk district:

Section 3 Miles Northeast of Hunt, Elk District.

Monongahela Series (259')	Thickness Feet.	Total Feet.	
Sandstone, massive, coarse, Uniontown..	60	60	
Red shale	25	85	
Sandstone, shelly, Arnoldsburg	25	110	
Red shale	15	125	
Sandstone, Sewickley	40	165	
Red shale	18	183	
Sandstone, massive, Pittsburgh	74	257	
Fire clay (Pittsburgh coal horizon).....	2	259	259'
Conemaugh Series (126')			
Sandy shale	16	275	
Sandstone, Lower Pittsburgh	70	345	
Sandy shale	10	355	
Sandstone, Connellsville	30	385	126'

Adding 45 feet to this thickness (259'), the interval below the base of the Dunkard series, where the section begins, gives the thickness of the Monongahela series here as 304 feet.

The following section was measured with aneroid by Teets from a high point near the Roane-Kanawha county line, descending southward to head of a small stream emptying into Pocatalico fork ¾ mile above mouth of the latter:

Section 3 Miles North of Hunt P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (225')			
Concealed	10	10	
Sandstone, massive, Arnoldsburg	40	50	
Sandy shale	25	75	
Red shale	20	95	
Sandy shale	25	120	
Sandstone, Sewickley	35	155	
Red shale	8	163	
Limestone, impure	2	165	
Sandstone, massive, coarse, Pittsburgh	55	220	
Fire clay and shale, (Pittsburgh coal horizon)	5	225	225'
Conemaugh Series (110')			
Sandstone, massive, Lower Pittsburgh	35	260	
Sandy shale	15	275	
Sandstone, massive, medium coarse, Connellsville	60	335	110'

The above section begins about 90 feet under the base of the Dunkard, which added will make the total thickness of the Monongahela series 315 feet at this point.

A section was measured by Krebs from the top of a high hill, descending southward to Island Branch P. O., Poca district, as follows:

Section at Island Branch P. O., Poca District.

	Thickness Feet.	Total Feet.	
Dunkard Series (65')			
Sandstone, massive, pebbly, Waynesburg	65	65	65'
Monongahela Series (271')			
Sandy and red shale	35	90	
Sandstone, Gilboy	35	125	
Red and sandy shale	20	145	
Sandstone, massive, Uniontown	60	205	
Red and sandy shale	10	215	
Sandy shale and sandstone	45	260	
Red shale	5	265	
Sandstone	20	285	
Red and sandy shale	30	315	
Limestone, impure	1	316	
Concealed	3	319	
Coal blossom	2	321	
Concealed	12	333	
Coal blossom, Pittsburgh	3	336	271'

The above section makes the thickness of the Monongahela rocks 271 feet, and adding 25 feet for dip will make the total thickness 296 feet.

The coal blossom appearing 12 feet above the Pittsburgh bed is possibly one of the "roof" coals of the latter.

DESCRIPTION OF THE MONONGAHELA FORMATIONS.

The Waynesburg Coal.

The highest formation of the Monongahela series is the Waynesburg coal and was so named from Waynesburg, Greene county, Pennsylvania, where the coal has been mined for many years.

Dr. I. C. White, in Volume II., page 147, of the West Virginia Geological Survey, gives a general description of this bed to which the reader is referred.

In the Kanawha county area no openng of this coal was found where the bed could be measured. In the southern part of Jackson county this seam is mined in several places, but the coal is impure and of little commercial value.

The following measurements were taken at an opening on waters of White Oak creek of Poca river, Washington district, Jackson county, 3 miles north of Island Branch P. O., and 1.5 miles north of the Kanawha-Jackson county line, where this coal is mined by Alex. Jones:

Section of Alex. Jones Coal Opening.

Slate Roof—	Feet.	Inches.
Coal, hard	1	2
Fire clay	..	6
Coal, impure	..	10
Fire clay bottom.	—	—
Total	2	6

The Gilboy Sandstone.

At from 5 to 10 feet below the Waynesburg coal there often appears a massive sandstone, ranging in thickness from 20 to 40 feet, that has been named the Gilboy by Dr. I. C. White, from a railroad cut of that name, located a short distance east of Mannington, Marion county. A description of

this sandstone is given in Volume II, page 150, of the West Virginia Geological Survey, 1903, to which the reader is referred.

In Kanawha county this sandstone frequenty makes cliffs or steep slopes around the hillsides just under the Waynesburg coal horizon. The area covered by this sandstone lies in the northern part of Poca and Union districts.

The Uniontown Sandstone.

At 10 to 20 feet below the Gilboy sandstone there frequently occurs another bluish gray, brown and massive sandstone that has been designated by Dr. I. C. White the **Uniontown,** from its relation to the underlying coal.

In Kanawha county this sandstone forms massive cliffs in Poca district along the Kanawha-Roane county line and on Middle fork of Pocatalico river.

The Uniontown Coal.

At 1 to 10 feet below the Uniontown sandstone and 75 to 110 feet below the Waynesburg coal there comes a fairly persistent bed that has been named the **Uniontown coal** from a city in Pennsylvania where it crops. It rarely exceeds 3 feet in thickness in West Virginia, and quite frequently is represented by only a few inches of black slate.

In Kanawha county this coal is generally absent. It is exposed on the waters of Derrick creek in Poca district, 3½ miles northwest of Sissonville where the following section was taken:

Sandstone, massive, (Uniontown)	
Coal and slate interlaminated	16"
Fire clay bottom	

Another opening on Trace fork of Pocatalico river shows practically the same section.

The Arnoldsburg Sandstone.

At from 40 to 50 feet underneath the Uniontown sandstone, there often occurs a coarse, gray, massive sandstone

that has been named by Ray V. Hennen the **Arnoldsburg sandstone** from a town of that name in Calhoun county* where it crops.

In Kanawha county this sandstone often becomes massive and forms bold cliffs in Poca, Union and the northern part of Elk districts, attaining a thickness of 40 feet. Quite frequently the sandstone is displaced by sandy shale.

The Sewickley Sandstone.

At 60 to 80 feet above the Pittsburgh coal there occurs in the northern part of Kanawha county a great, coarse, gray massive, often pebbly sandstone, ranging in thickness from 20 to 45 feet. It forms massive cliffs along Goose creek of Campbell creek and Island branch, also abrupt bluffs are formed along Tupper creek by the top portion of this sandstone.

The Sewickley Coal.

The Sewickley coal coming underneath the Sewickley sandstone is usually represented by a dark fireclay with slate. At the mouth of White Oak creek of Pocatalico river, about 1 mile south of Cicerone P. O. and about ¼ mile east of the Kanawha-Roane county line, the blossom of this coal shows along the county road leading up the former stream where it is only 4 inches thick.

A blossom of this coal was also observed on the hillside along Goose creek of Pocatalico river, but no opening was found where the coal could be measured.

The Upper Pittsburgh-Pomeroy Sandstone.

At from 200 to 250 feet below the base of the Waynesburg sandstone, there occurs a massive coarse, grayish brown, pebbly sandstone which has been called the **Pittsburgh sandstone** by H. D. Rogers, from its relation to the coal bed of that name. Dr. I. C. White gives a general description of this

*Wirt-Roane-Calhoun Report, pp. 202-204, West Virginia Geological Survey, 1911.

sandstone in Vol. II, page 163, West Virginia Geological Survey, 1903. It crops in massive abrupt cliffs in the northern part of Kanawha county along the tributaries of Pocatalico river flowing from the east, until the bed rises to the top of the highest hills and caps the knobs north of Elk river.

On Goose and Green creeks the Upper Pittsburgh sandstone reaches a thickness of 60 feet and is very massive and pebbly. On Leatherwood, Racoon and Tupper creeks, it forms massive cliffs from 40 to 50 feet high, and where the sandstone does not outcrop it forms abrupt slopes.

The Upper Pittsburgh sandstone caps Holmes knob in Union district and forms massive cliffs along the head waters of the Right fork of Kanawha Two Mile creek.

In Jefferson district at the head of Tacketts creek at the Kanawha-Putnam county line, the Upper Pittsburgh sandstone forms cliffs 50 to 60 feet high, and is coarse, grayish, and full of large pebbles. This sandstone also caps the hills in Union district north of Saint Albans in abrupt cliffs 40 to 60 feet high.

In Elk district the Upper Pittsburgh sandstone forms massive cliffs along the waters of Little Sandy and Wills creeks, and capping the highest hills north of Blue creek.

In Big Sandy district, this stratum crops in the hills along the head of Wills creek, Gabes creek, Buffalo run and Doctors creek, in cliffs 50 to 60 feet high. It caps the highest knobs along Jordans creek and Sand run. It also caps the high hills just south of Walgrove on Elk river, making a cliff 40 feet high.

The Redstone coal appears to be almost entirely absent in the Kanawha county area, unless the coal blossom in the Island Branch section coming 12 feet above the Pittsburgh horizon could be the **Redstone bed.**

The Pittsburgh Coal.

The Pittsburgh coal is the lowest and last member of the Monongahela series and is one of the most valuable and important coal beds in the Appalachian Basin. It was named by J. P. Lesley in 1856 from the city of Pittsburgh, Pa., where it crops high up in the river hills. Dr. I. C. White, on page 164,

of Vol. II, of the State Geological Survey, gives a very interesting account of this great coal seam, and its influence on the industrial growth of the city and northern West Virginia.

In the Kanawha county area the Pittsburgh coal occurs in a portion of Union and Poca districts, where it crops in the hills above water level, except a small portion north of Pocatalico river, on Frog and Kelley creeks. Small areas are also found in the tops of the highest hills in Jefferson district south of Saint Albans.

The approximate eastern boundary line **where the Pittsburgh coal bed of commercial thickness** and purity **disappears** is outlined in detail on the Economic Geologic map accompanying this report.

The first geologist to make a detailed study of the structure of this coal was Dr. J. J. Stevenson. In report K of the Second Geological Survey of Pennsylvania, he shows a series of thin parting clays and slates subdividing the vein into several distinct beds as follows:

1. **Roof coals.**
2. **Over clay.**
3. **Breast coal.**
4. **Parting.**
5. **Bearing-in coal.**
6. **Partings.**
7. **Brick coal.**
8. **Parting.**
9. **Bottom coal.**

A full description of the character and thickness of these separate beds is given by I. C. White on pages 166-172 of Vol. II, W. Va. Geol. Survey.

There are many local mines on the head waters of Kanawha Two Mile creek and Tuppers creek where the coal is mined and hauled to Charleston in wagons. The following section was measured at the Haynes mine on the headwaters of Two Mile creek, 2 miles north of Guthrie, which gives the general structure of the coal.

Section of Haynes Mine.

Sandstone, massive		1′ 0″
Shale		1′ 0″
Coal, impure	0′-6″	
Shale	1′-0″	
Coal, impure	0′-5″	8′ 4″
Coal, hard	3′-0″	
Bone	1″	
Coal, hard, block	3′-4″	

The above section gives the general structure of the coal and it conforms in a general way to that of the coal mined along the Monongahela river, except that this coal in Kanawha county is very hard and practically a "block" coal.

The thickness, character and composition of the coal at the several openings will be discussed in detail in a subsequent chapter on the coal resources of the county, also an estimate will be given on the probable available area and the total tonnage of the bed* by districts.

*It is barely possible that this bed may represent the Redstone as claimed by Bownocker, State Geologist of Ohio, but the question cannot be definitely determined in West Virginia until the detailed geology of Lewis, Gilmer, Braxton and Clay is studied (I. C. W.)

CHAPTER VII.

THE CONEMAUGH SERIES.

The rocks between the floor of the Pittsburgh bed and roof of the Upper Freeport coal were named by Mr. Franklin Platt in 1875, the **Conemaugh series,** from their outcrop along the Conemaugh river in Cambria county, Pennsylvania. These beds were formerly known as the Lower Barren Measures. Dr. I. C. White gives an interesting account of this series in Vol. II, pp. 225-226, W. Va. Geol. Survey, 1903.

A general section of the Conemaugh series in West Virginia has been compiled by Krebs from a large number of detailed sections of these measures as published in the report of the State Survey mostly from northern West Virginia. As these rocks were first studied and described in Pennsylvania a large percentage of the names are taken from places in that State. Later several have been added from Ohio and West Virginia.

General Section of Conemaugh Series in West Virginia.

	Thickness Feet.	Total Feet.	
Fire clay and shale	5	5	
Sandstone, massive, Lower Pittsburgh	35	40	
Shale	3	43	
Upper Pittsburgh limestone	4	47	
Coal, Little Pittsburgh	1	48	
Fire clay and gray shale	7	55	
Lower Pittsburgh limestone	10	65	
Shale, sandy and red	58	123	
Sandstone, usually massive and pebbly, Connellsville	25	148	
Coal, Little Clarksburg	2	150	
Shale, dark	5	155	
Limestone, gray and hard, Clarksburg	10	165	
Shale, sandy and red	48	213	
Sandstone, massive, Morgantown	40	253	
Coal, Elk Lick	2	255	105'
Fire clay and shale	10	265	

	Thickness Feet.	Total Feet.	
Limestone, gray, Elk Lick	5	270	
Shale, sandy, Birmingham	10	280	
Sandstone, massive, pebbly, Grafton	20	300	
Limestone, fossiliferous, Upper Ames	4	304	
Shale, fossiliferous, dark green	15	319	
Limestone, fossiliferous, Lower Ames	3	322	
Shale, dark	6	328	
Coal, Harlem	2	330	75
Fire clay and shale, red	10	340	
Limestone, gray, Ewing	5	345	
Red shale, "Pittsburgh Reds"	40	385	
Sandstone, massive, Saltsburg	40	425	
Coal, Bakerstown	1	426	
Fire clay	3	429	
Limestone, Pine Creek	1	430	
Shale	15	445	
Sandstone, massive, pebbly, Buffalo	50	495	69′
Brush Creek Limestone 5′ Shale, black 10′ Coal, Brush Creek, Sandstone, Mahoning, to base of series 80′	95	590	95′

Sections.

In addition to the sections of the Conemaugh series that have already been published in Chapter IV, several scattered sections of these measures will now be given.

The following section measured by Teets begins at the summit of a high point about one mile southeast of Saint Albans and descends northwestward along the county road to the C. & O. depot in Saint Albans:

Saint Albans Section, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (23′)			
Concealed	20	20	
Coal blossom, Pittsburgh	3	23	23′
Conemaugh Series (422′)			
Sandstone, massive. Lower Pittsburgh	47	70	
Fire clay, Lower Pittsburgh	2	72	
Red shale	8	80	
Sandstone, massive, medium coarse, Connellsville	25	105	
Limy shale	5	110	
Red, sandy shale	70	180	
Sandstone, massive, medium coarse, Morgantown	50	230	
Red and limy shale	25	255	

	Thickness Feet.	Total Feet.
Sandy shale	10	265
Sandstone, massive, coarse, Grafton	65	330
Red shale, limy	3	333
Limestone	1	334
Sandstone, friable	16	350
Red shale, light colored	10	360
Sandy shale and sandstone	50	410
Limestone, (Ames horizon)	1	411
Sandy shale and sandstone to C. & O. R. R.	34	455

It is about 150 feet lower to the base of the Conemaugh series at this locality and this would make the thickness of the series 572 feet.

The following section was measured by Krebs with aneroid, along the road descending hill southeastward, one mile west of Institute, Union district.

Section One Mile West of Institute, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (56')			
Sandstone, massive	52	52	
Fire clay (Pittsburgh coal horizon)	4	56	56'
Conemaugh Series (305')			
Sandy shale	22	78	
Sandstone, Lower Pittsburgh	12	90	
Sandy shale	27	117	
Black slate	1	118	
Red, limy shale	12	130	
Sandstone, massive	35	165	
Red shale and limestone nodules	10	175	
Sandstone	14	189	
Red shale	7	196	
Sandstone	29	225	
Limestone, impure	1	226	
Red shale	5	231	
Sandstone	14	245	
Sandy shale	38	283	
Red shale	7	290	
Sandstone	15	305	
Sandy shale	17	322	
Limestone, dark	1	323	
Red shale, iron ore nodules	7	330	
Sandstone	11	341	
Red, limy shale. (Elev. equals 624' A. T. B.)	20	361	361'

The following section was measured by Teets from a high point in Union district, 1¾ miles south 30° west from Wallace P. O., along a county road to head of Fisher branch of Rocky Fork:

Section 1.8 Miles Southwest of Wallace P. O., Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (165')			
Sandstone, massive, coarse	50	50	
Red shale	3	53	
Sandstone, massive, top portion fine grained, lower portion coarse and friable	52	105	
Fire clay	2	107	
Sandstone	53	160	
Coal, Pittsburgh, reported	5	165	165'
Conemaugh Series (230')			
Sandstone, Lower Pittsburgh	20	185	
Red shale	5	190	
Sandy shale	15	205	
Red shale	5	210	
Sandstone, flaggy	20	230	
Dark red shale with limestone nodules	10	240	
Sandstone, massive	25	265	
Fire clay	2	267	
Red shale, dark limestone nodules	18	285	
Sandstone and concealed	44	329	
Slaty shale	1	330	
Sandstone, massive, coarse, Morgantown to 725' A. T. B.	65	395	230'

The one foot of slaty shale may represent the **Little Clarksburg coal,** except that the interval of 165 feet below the **Pittsburgh coal** appears a little too great.

The following section, measured by Teets, begins near the corner of Washington and Jefferson districts, Kanawha county, and descends northwest to Falls creek, one-fourth mile north of the Kanawha and Lincoln county line:

Section 1.7 Miles West of Lincoln, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (30')			
Sandstone and concealed	28	28	
Fire clay (Pittsburgh coal horizon)	2	30	30'
Conemaugh Series (335')			
Sandstone, massive, Lower Pittsburgh	30	60	
Red shale and concealed	60	120	
Sandstone, massive	5	125	
Sandy shale and concealed	25	150	
Sandstone and sandy shale	40	190	
Red, limy shale	45	235	
Limestone and fire clay, Little Clarksburg	5	240	
Sandstone	20	260	

	Thickness Feet.	Total Feet.	
Sandstone, massive, medium coarse, Morgantown	40	300	
Sandy shale and concealed	35	335	
Sandstone, massive, Grafton	28	363	
Limestone, hard, bluish color to creek level. (Elev. 685' A. T. L.)	2	365	335'

The following section was measured by Mr. Teets with aneroid from a point 1.5 miles northeast of Bonami P. O., along the county road to the southwest to a branch of Alum creek:

Section One Mile Northeast of Bonami P. O., Washington District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (434')			
Concealed	50	50	
Sandstone	20	70	
Red shale	5	75	
Sandstone	15	90	
Sandy shale	5	95	
Sandy shale and limestone	40	135	
Fire clay, Elk Lick coal	2	137	
Red and sandy shale	18	155	
Sandstone, Grafton	35	190	
Red shale	10	200	
Sandy shale and concealed	25	225	
Sandstone, massive, medium coarse	50	275	
Sandy shale	5	280	
Sandstone, massive, medium coarse	25	305	
Sandy shale	21	326	
Red shale	4	330	
Limestone, impure	1	331	
Sandstone, massive	34	365	
Sandy shale and concealed	25	390	
Fire clay	1	391	
Concealed	14	405	
Sandstone, massive	29	434	434'
Allegheny Series (1')			
Coal blossom (Upper Freeport) 780' A. T. B.	1	435	

The following section was measured by Teets with aneroid, from a high point one mile west of the Aetna schoolhouse down a private road to Rocky fork one mile northeast of the Fairview church:

Section One Mile West of Aetna School House, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (131')			
Sandy shale and concealed	40	40	
Sandstone, massive, coarse grained, friable	90	130	
Coal blossom, Pittsburgh	1	131	131'
Conemaugh Series (339')			
Sandstone, Lower Pittsburgh	14	145	
Red and sandy shale	15	160	
Sandstone	15	175	
Red shale	5	180	
Sandstone	45	225	
Red limy shale	40	265	
Sandstone, flaggy	20	285	
Red shale	10	295	
Sandstone, Morgantown	45	340	
Red shale	5	345	
Sandy shale	5	350	
Sandstone	30	380	
Limestone, Elk Lick	1	381	
Sandstone and concealed	89	470	339'

Another section was measured from a point just west of the head of Upton creek at the Jefferson and Washington district line, 7¼ miles south 85° west from Charleston, down hill eastward to head of Upton creek, as follows:

Section 2.3 Miles Southwest of Spring Hill, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (49')			
Concealed	20	20	
Red shale	5	25	
Sandstone, massive, Pittsburgh	20	45	
Coal, Pittsburgh, reported	4	49	49'
Conemaugh Series (411')			
Sandstone and concealed	106	155	
Red shale	5	160	
Sandy shale	10	170	
Red shale	15	185	
Sandstone, massive, coarse, Morgantown	65	250	
Red and sandy shale	50	300	
Sandy shale	59	359	
Coal blossom, Harlem	1	360	
Sandy shale	15	375	
Sandstone, massive, Saltsburg	53	428	
Fire clay (**Bakerstown coal horizon**)	2	430	
Sandstone, massive (Buffalo) to 620' A. T.	30	460	411'

This section shows the interval between the **Pittsburgh coal** and the **Harlem coal** to be 310 feet. The section ends about 120 feet above the base of the Conemaugh series, which added to 411 feet will make the thickness of the Conemaugh series 531 feet at this locality.

The following section was measured by Krebs in the extreme northwestern section of Washington district, Kanawha county, at a point about ½ mile north of the mouth of Mennens branch, and ¼ mile west of Coal river:

Section 1.5 Miles Northwest of Lincoln, Washington District.

Conemaugh Series (415')		Thickness Feet.	Total Feet.	
Concealed		60	60	
Red shale		10	70	
Sandy shale, sandstone and concealed		65	135	
Sandy shale, reddish color		10	145	
Sandy shale and sandstone		25	170	
Sandstone, fine grained..20' / Sandstone, conglomeratic. 5' / Sandstone, fine grained..15'	Morgantown	40	210	
Red sandy shale		10	220	
Limestone and limy shale, Elk Lick		5	225	
Sandstone, flaggy		35	260	
Sandy shale		10	270	
Red, limy shale		10	280	
Limestone		1	281	
Sandstone, fine grained, Grafton		59	340	
Limestone, hard, bluish color, (Ames horizon)		3	343	
Limy, red shale		17	360	
Fire clay, Harlem Coal		2	362	
Sandstone, massive, fine grained, Saltsburg		33	395	
Sandy shale and concealed to 590' A. T. B.		20	415	415'

This section would make the interval between the **Pittsburgh coal** and Elk Lick limestone 225 feet, and between the **Pittsburgh** and **Harlem** coals 360 feet.

The following section begins on a high point, 500 feet west of J. M. Burgess' residence, 3 miles south 10° east from St. Albans and about 1¼ miles east from Upper Falls station, and descends past the J. M. Burgess coal bank and along the county road to the southwest to Smith creek, at a point about one mile east of Upper Falls:

Section 3 Miles Southeast of St. Albans, Washington District.

	Thickness Feet.	Total Feet.	
Monongahela Series (29')			
Concealed	25	25	
Coal, Pittsburgh	4	29	29'
Conemaugh Series (451')			
Sandstone, massive, coarse, friable, Lower Pittsburgh	51	80	
Fire clay	2	82	
Sandy shale	8	90	
Sandstone, friable	30	120	
Red shale	5	125	
Limestone, nodular	5	130	
Red, sandy shale	32	162	
Red shale with limestone nodules	8	170	
Sandy shale	20	190	
Sandstone, coarse grained	25	215	
Sandy shale	14	229	
Coal blossom	2	231	
Sandstone	24	255	
Sandy shale	15	270	
Red shale	5	275	
Sandstone, coarse, very friable, Grafton	42	317	
Red shale and fire clay	3	320	
Sandstone, medium coarse, friable	45	365	
Sandy shale and sandstone, Saltsburg	58	423	
Fire clay (Bakerstown)	2	425	
Sandstone, medium coarse	20	445	
Reddish, sandy shale	5	450	
Sandy shale	8	458	
Fire clay	1	459	
Sandstone and concealed to 588' A. T. L.	21	480	451'

If we add 30 feet to the above section for correction for rise of the strata and 60 feet more to the base of the **Conemaugh series,** it will make the thickness of the Conemaugh 541 feet, at this point, or nearly the same as that (531') found 2 1/3 miles southwest of Spring Hill.

The following section was measured with aneroid by Teets from a high point on divide between Angel Fork and Falls creek, down the hill to the head of Falls creek. The beginning point is about ¾ mile north of the Kanawha and Lincoln county line, in Jefferson district:

Section 4 Miles Southwest of Tornado P. O., Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (20')			
Concealed	18	18	
Fire clay, (Pittsburgh coal horizon)	2	20	20'

	Thickness Feet.	Total Feet.	
Conemaugh Series (345')			
Limestone, nodular	2	22	
Red, limy shale	33	55	
Sandy and red shale	15	70	
Sandstone	20	90	
Red shale	30	120	
Sandstone and sandy shale	15	135	
Red shale	5	140	
Sandy shale	15	155	
Fire clay (Little Clarksburg coal)	1	156	
Sandy shale	9	165	
Concealed	30	195	
Sandstone, Morgantown	25	220	
Fire clay	1	221	
Sandy shale and sandstone	44	265	
Sandy shale	25	290	
Coal blossom, Elk Lick	1	291	
Red shale	14	305	
Sandstone and concealed	58	363	
Limestone (Ames horizon). (Elev. 665' A. T. L.)	2	365	345'

The following section was measured by Teets with aneroid from a point on the divide between Browns creek and Coal river, eastward down hill to Coal river at a point one mile below the mouth of Browns creek:

Section 1.5 Miles West of Moore School, Jefferson District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (345')			
Concealed	20	20	
Sandstone, massive, medium coarse, Connellsville	60	80	
Sandy shale and concealed	30	110	
Sandstone, medium coarse, making prominent cliffs, Morgantown	30	140	
Sandy shale and concealed	20	160	
Limestone ledge, impure, Elk Lick	2	162	
Sandstone, massive cliff	33	195	
Red and sandy shale and concealed	20	215	
Sandstone, massive, medium coarse, Grafton	25	240	
Limestone, impure, (Ames horizon)	3	243	
Sandy shale and concealed	17	260	
Sandstone and concealed	30	290	
Concealed to Coal river, at 575' A. T. B.	55	345	345'

The above section begins about 60 feet below the base of the Pittsburgh coal horizon.

The following section was measured by Teets, from a point in the divide between Coal river and Browns creek down the hill to the northwest to a point on Browns creek about one mile above the mouth of said creek:

Section 1¼ Miles North of Tornado P. O., Jefferson District.

Conemaugh Series (205')	Thickness Feet.	Total Feet.	
Sandstone and sandy shale	33	33	
Red shale	2	35	
Sandy shale and concealed	59	94	
Fire clay	1	95	
Red, limy shale	24	119	
Limestone, gray (Ames horizon)	1	120	
Sandy shale	14	134	
Fire clay (Harlem coal horizon)	1	135	
Red, limy shale	15	150	
Sandy shale	5	155	
Sandstone, massive, coarse grained, Saltsburg	39	194	
Coal blossom, Bakerstown	1	195	
Sandstone and concealed to 595' A. T. B.	10	205	205'

The above section gives the interval between the **Harlem coal** and the **Bakertown coal** as 60 feet.

The following section begins on a point in a sharp bend in Coal river, near Lincoln station, and descends westward to the C. & O. R. R. track at a point ½ mile below Lincoln station, Washington district:

Lincoln Station, Washington District.

Conemaugh Series (140')	Thickness Feet.	Total Feet.	
Concealed	10	10	
Sandstone, massive, Grafton	33	43	
Limestone, impure, Upper Ames	2	45	
Sandy shale	30	75	
Red, limy shale	20	95	
Sandstone, massive, Saltsburg	29	124	
Coal blossom, Bakerstown	1	125	
Limestone and limy shale	5	130	
Sandstone, ferriferous, (Buffalo) to track level	10	140	140'

The following section was measured with aneroid by Teets, from top of hill ¼ mile west of Coal river, down the hill to Coal river at a point 0.7 mile west of Lower Falls:

Section 0.7 Mile West of Lower Falls, Jefferson District.

Conemaugh Series (230')	Thickness Feet.	Total Feet.	
Concealed	10	10	
Sandstone, Morgantown	20	30	
Coal, Elk Lick	2	32	
Sandy shale and concealed	38	70	
Red shale	20	90	
Sandstone and concealed	45	135	
Limestone and limy shale	3	138	
Light red shale	2	140	
Red and sandy shale	40	180	
Limestone, impure	2	182	
Red shale	18	200	
Sandstone and concealed to Coal river at 575' A. T. B.	30	230	230'

The following section was measured with hand level by Krebs, descending from a high hill from the north to Browns creek, 2.3 miles northwest of Tornado P. O., Jefferson district:

Section 2.3 Miles Northwest of Tornado, Jefferson District.

Conemaugh Series (330')	Thickness Feet.	Total Feet.	
Red and sandy shale	25	25	
Sandstone, massive, Connellsville	50	75	
Red limy shale	15	90	
Sandy shale and concealed, Morgantown	43	133	
Red, limy shale	5	138	
Limestone, impure, Elk Lick	2	140	
Sandy shale and sandstone	50	190	
Red, limy shale	5	195	
Sandstone and concealed	35	230	
Limestone	1	231	
Sandy shale	8	239	
Coal blossom, Harlem	3	242	
Slate and concealed	8	250	
Limestone, gray	3	253	
Sandy shale	7	260	
Sandstone, massive, Saltsburg	23	283	
Coal blossom (Bakerstown?)	2	285	
Concealed to creek, at 645' A. T. B.	45	330	330

The foregoing section begins about 80 feet below the base of the Pittsburgh coal, which would make the interval between the **Harlem** and **Pittsburgh coals** 319 feet.

The following section was measured by Krebs with aneroid, descending from a high summit westward along the road leading to Alumville on Alum creek, Washington district:

Section at Alumville, Washington District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (339')			
Sandstone, buff, massive, Morgantown...	65	65	
Red and sandy shale	50	115	
Sandstone and sandy shale	14	129	
Limestone, bluish gray	2	131	
Red sandy shale	10	141	
Sandy shale	18	159	
Sandstone, massive, Saltsburg	45	204	
Coal blossom, Bakerstown	5	209	
Sandy shale	5	214	
Sandstone, massive, Buffalo	40	254	
Coal blossom, Brush Creek	2	256	
Sandstone and concealed	10	266	
Fire clay	2	268	
Sandstone and concealed, Mahoning.....	71	339	339
Allegheny Series (53')			
Fire clay, (Upper Freeport coal horizon)...	2	341	
Sandstone	10	351	
Dark fire clay	2	353	
Sandy shale and sandstone	6	359	
Dark fire clay	1	360	
Sandstone, massive, Upper Freeport	30	390	
Coal blossom, Lower Freeport	2	392	53'

The above section begins about 150 feet underneath the Pittsburgh coal horizon, which added to 339 feet, plus 50 feet, the correction for dip of strata, would make the thickness of the Conemaugh series at this point 539 feet.

The following section was measured by Teets from a high point near the source of Crooked creek, descending along the county road to a point in Crooked creek, near the schoolhouse at Ruth:

Section 2 Miles West of Ruth P. O., Washington District.

	Thickness Feet.	Total Feet.	
Monongahela Series (45')			
Sandstone and sandy shale, Pittsburgh..	45	45	45'
Conemaugh Series (375')			
Red, limy shale	15	60	
Sandstone, coarse, Lower Pittsburgh.....	34	94	
Limestone, hard	1	95	
Red shale	4	99	
Limestone, nodular	1	100	
Sandstone, massive, coarse	40	140	
Red, limy shale	35	175	
Sandstone, massive, friable, Connellsville	43	218	
Fire clay	2	220	
Sandstone, massive, Morgantown	63	283	

	Thickness Feet.	Total Feet.	
Fire clay (Elk Lick Coal)	2	285	
Red and sandy shale	15	300	
Sandstone and sandy shale	25	325	
Light red shale	3	328	
Fire clay	2	330	
Sandstone, massive, medium coarse, Grafton	43	373	
Fire clay	2	375	
Sandstone, coarse, Saltsburg. (Elev. 680' A. T. B.)	45	420	375'

The following section was measured by Teets from a high point south 25° east, 2¼ miles from St. Albans, southwest to a point ½ mile east of Ferrell station, on the Coal River Branch of the C. & O. R. R.:

Section ½ Mile East of Ferrell Station, Jefferson District.

	Thickness Feet.	Total Feet.	
Monongahela Series (48')			
Concealed	20	20	
Sandy shale	25	45	
Coal blossom, Pittsburgh	3	48	48'
Conemaugh Series (387')			
Sandstone and concealed	77	125	
Sandy shale and concealed	40	165	
Red shale	25	190	
Sandstone, massive...35 Sandy shale ..... 5 Sandstone, massive..20 } Morgantown	60	250	
Coal blossom, Elk Lick	2	252	
Sandstone	38	290	
Red shale	40	330	
Sandy shale and concealed	104	434	
Coal blossom, Bakerstown. (Elev. 625' A. T. B.)	1	435	387'

The above is an important section, since the Pittsburgh, Elk Lick and Bakerstown coals are all exposed in same.

The interval between the base of the Pittsburgh coal and Bakerstown coal is 387 feet, and adding 150 feet to the top of the Allegheny series, would make the thickness of the Conemaugh series at this point 537 feet.

The following section was measured by Teets from a point on a ridge between Fisher branch and Rocky fork, 7½ miles north 34° west from Charleston, southeast to mouth of Limestone branch, Union district, 0.7 mile northeast of Rocky Fork P. O.:

Section 0.7 Mile Northeast of Rocky Fork P. O. Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (105')			
Sandstone and concealed	100	100	
Coal, Pittsburgh	5	105	105'
Conemaugh Series (295')			
Sandy shale and concealed	70	175	
Sandy shale	15	190	
Fire clay	2	192	
Red shale	3	195	
Sandy shale and sandstone	20	215	
Red shale	20	235	
Sandy shale	10	245	
Red shale	10	255	
Sandy shale and sandstone	10	265	
Red shale	5	270	
Sandstone, massive	20	290	
Red shale	35	325	
Limy shale	3	328	
Sandy shale	7	335	
Dark red shale	10	345	
Sandstone, Grafton, massive and concealed to 615' A. T. B.	55	400	295'

The following section was obtained by measuring from a high point 1½ miles north 70° east fom St. Albans down the hill along a private road to the K. & M. R. R. track one mile east of Sattes:

Section 1 Mile East of Sattes, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (59')			
Concealed	55	55	
Coal, Pittsburgh, good	4	59	59'
Conemaugh Series (356')			
Sandy shale	41	100	
Sandstone, massive	40	140	
Sandy shale	10	150	
Red shale	5	155	
Sandy shale	10	165	
Red shale with limestone nodules	5	170	
Sandstone, massive, medium coarse, Connellsville	60	230	
Red and sandy shale	80	310	
Fire clay	2	312	
Sandstone	18	330	
Limestone, nodular	2	332	
Red shale	10	342	
Coal blossom, Harlem	1	343	
Sandy shale	7	350	
Sandstone	30	380	
Sandy shale to K. & M. R. R. track at 595' A. T. B.	35	415	356'

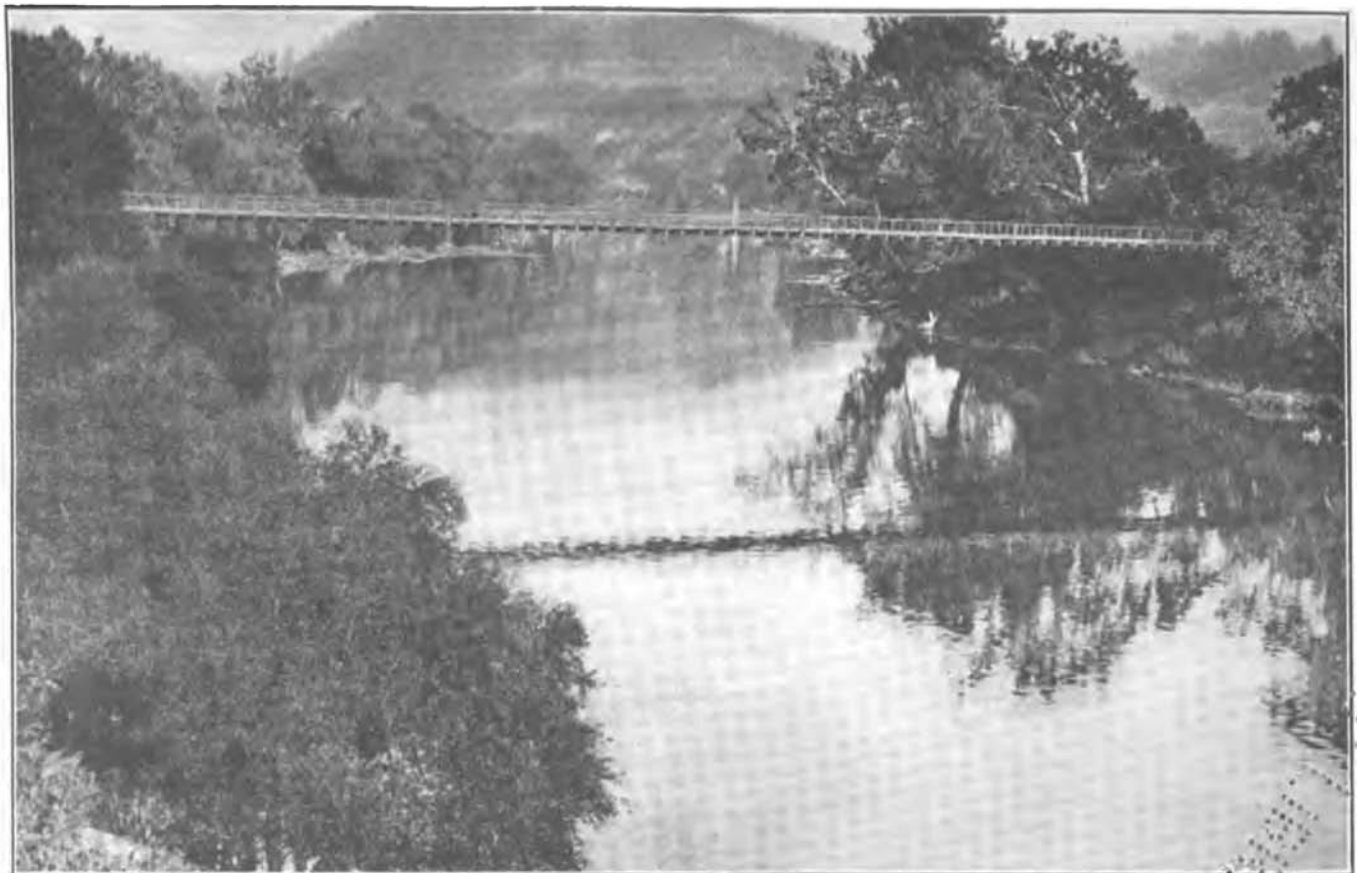


PLATE VIII.—Scene on Elk river at Charleston, showing the base of the Conemaugh, Allegheny and top of Kanawha Series.

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The above section shows the interval between the Harlem and Pittsburgh coals to be 284 feet at this locality.

The following section was measured with aneroid by Teets, descending from a high point on divide between Woodward branch and Left Fork of Two Mile, along the county road northwesterly to Left Fork of Two Mile creek, 3.5 miles northwest of Charleston:

Section 3.5 Miles Northwest of Charleston, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (20')			
Sandstone and concealed, Pittsburgh	20	20	20'
Conemaugh Series (345')			
Red shale	10	30	
Sandy shale and concealed	50	80	
Sandstone	20	100	
Sandy shale	10	110	
Red shale	5	115	
Limy red shale	10	125	
Sandstone, friable, massive, Connellsville	25	150	
Sandy shale and concealed	40	190	
Red shale	5	195	
Sandstone and concealed	20	215	
Red shale	5	220	
Fire clay	2	222	
Sandstone, massive, Morgantown	28	250	
Red shale	5	255	
Coal blossom, Elk Lick	1	256	
Red shale	9	265	
Sandstone and concealed	20	215	
Red shale and fire clay.....	12	297	
Sandstone concealed	68	365	345'

The above section shows the interval between the base of the Pittsburgh sandstone and Elk Lick coal to be 235 feet.

The following section was measured by Krebs with aneroid, descending southward to Magazine branch one mile north of Charleston, Charleston district:

Section One Mile North of Charleston, Charleston District.

	Thickness Feet.	Total Feet.
Conemaugh Series (380')		
Sandstone, Lower Pittsburg	30	30
Sandy shale	30	60
Sandstone	20	80
Red shale	5	85
Sandstone	18	103
Sandy shale	42	145

	Thickness Feet.	Total Feet.	
Red shale	15	160	
Sandstone	24	184	
Sandy shale	10	194	
Red shale	6	200	
Sandstone, flaggy, Morgantown	30	230	
Sandy shale	12	242	
Red shale, limestone nodules	10	252	
Sandstone	18	270	
Red and sandy shale	10	280	
Limestone	2	282	
Sandy shale	26	308	
Sandstone	22	330	
Yellow, limy shale	4	334	
Coal, impure, Harlem	2	336	
Blue shale	2	338	
Sandy shale	2	340	
Sandstone, massive, conglomeratic, (Buffalo)	33	373	
Coal, impure, Bakerstown	2	375	
Sandstone and concealed	5	380	380′

The following section was measured with aneroid by Krebs, descending from a high knob one mile south of Holmes knob, southward to Eden Fork of Two Mile creek, Union district:

Section One Mile South of Holmes Knob, Union District

	Thickness Feet.	Total Feet.	
Monongahela Series (63′)			
Sandstone, massive, Pittsburgh	60	60	
Coal, Pittsburgh	3	63	63
Conemaugh Series (360′)			
Sandy shale	20	83	
Sandstone, Lower Pittsburgh	60	143	
Red shale, limestone nodules	50	193	
Sandstone, buff, Connellsville	28	221	
Coal blossom, Clarksburg	2	223	
Red shale and limestone nodules	11	234	
Sandstone	19	253	
Red shale	55	308	
Sandstone, Morgantown (?)	15	323	
Red shale, limestone nodules	15	338	
Sandstone, shelly	5	343	
Red shale	2	345	
Sandstone, friable	12	357	
Red shale	6	363	
Sandstone, Grafton	12	375	
Sandy shale	7	382	
Red shale	11	393	
Concealed	10	403	
Sandstone, Saltsburg, to creek	20	423	360′

The foregoing section shows the Morgantown and Grafton sandstone broken up into sandy and red shales.

The following section was measured by Krebs with aneroid, descending along road to Tyler creek, 2 miles northeast of Dunbar, Union district:

Section 2 Miles Northeast of Dunbar, Union District.

	Thickness Feet.	Total Feet	
Monongahela Series (135')			
Sandy shale	20	20	
Sandstone and concealed	110	130	
Fire clay (Pittsburgh coal horizon)	5	135	135'
Conemaugh Series (225')			
Sandy shale	20	155	
Sandstone, flaggy	25	180	
Sandy shale	15	195	
Red shale	17	212	
Sandstone, fine grained, Connellsville	28	240	
Dark, red shale	20	260	
Sandy shale	13	273	
Limestone, reddish	2	275	
Sandstone	10	285	
Red shale	20	305	
Sandstone, fine grained, buff	10	315	
Red shale	15	330	
Sandstone, Morgantown, to 700' A. T. B.	30	360	360'

The following section was measured with aneroid by Krebs, descending westward from the summit of a high hill, at Lock Seven, Union district:

Section at Lock Seven, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (80')			
Red, limy shale	20	20	
Sandstone, massive, coarse, Pittsburgh	80	100	80'
Conemaugh Series (340')			
Red shale	20	120	
Sandy shale	26	146	
Red shale	4	150	
Sandy shale and sandstone	60	210	
Red and sandy shale	35	245	
Sandstone, Morgantown	40	285	
Dark red shale, limestone nodules	55	340	
Sandstone, flaggy, Grafton	50	390	
Red shale and concealed to 600' A. T. B.	30	420	340'

The following section was measured by Teets from a high point N. 5° W. 3.5 miles from Charleston, down the hill southwestward to county road 0.7 mile east of Guthrie P. O.:

Section 0.7 Mile East of Guthrie P. O., Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (85')			
Sandy shale	40	40	
Sandstone, massive, Pittsburgh	40	80	
Coal, Pittsburgh	5	85	85'
Conemaugh Series (430')			
Sandstone and concealed	55'-9"	140	
Sandy shale and concealed	60	200	
Red shale with limestone nodules	20	220	
Sandstone, massive	15	235	
Red shale	2	237	
Sandstone, massive, Morgantown	48	285	
Fire clay (Elk Lick coal horizon)	2	287	
Sandy shale	28	315	
Dark, red shale	20	335	
Sandstone, massive, medium coarse, Grafton	40	375	
Limestone and limy shale	5	380	
Fire clay	2	382	
Sandstone	48	430	
Limestone, Two-Mile	2	432	
Sandstone, Saltsburg	33	465	
Sandy shale and concealed to 590' A. T. B.	50	515	430'

This section shows the interval between the **Pittsburgh coal** and the **Two Mile limestone** to be 345 feet.

The following section was measured by Teets with aneroid, from a point at head of Sigman Fork and Right Fork at the Poca and Union district line, 7¼ miles N. 18° E. from Charleston, down the hill northwest to head of Sigman Fork:

Section 2 Miles Southeast of Legg P. O., Poca District.

	Thickness Feet.	Total Feet.	
Monongahela Series (122')			
Sandy shale, sandstone and concealed	100	100	
Sandstone	20	120	
Coal blossom, Pittsburgh	2	122	122'
Conemaugh Series (248')			
Sandy shale and concealed	38	160	
Sandstone, massive	24	184	
Coal blossom, Little Pittsburgh	1	185	
Sandstone and concealed	25	210	
Sandy shale	10	220	
Fire clay	2	222	
Sandstone and sandy shale	53	275	
Red shale	5	280	
Sandy shale	20	300	
Sandstone, massive, coarse, Morgantown.	40	340	
Red and sandy shale to 775' A. T. B.	30	370	248'

This section gives the interval between the Pittsburgh and Little Pittsburgh coal as 62 feet.

The following section was measured by Teets from a point near the Union and Elk district line, one mile north of Holmes Knob, down the hill southwest to head of Copen Branch of the Right Fork of Two Mile creek:

Section One Mile South of Holmes Knob, Union District.

	Thickness Feet.	Total Feet.	
Monongahela Series (185')			
Sandy shale and concealed	40	40	
Red shale	5	45	
Sandstone, massive, Sewickley	65	110	
Sandy shale	25	135	
Sandy shale and sandstone, Pittsburgh	45	180	
Coal, good, Pittsburgh	5	185	185'
Conemaugh Series (230')			
Sandstone and concealed	30	215	
Sandy shale	10	225	
Sandstone, massive and concealed	60	285	
Sandy shale	15	300	
Red shale	5	305	
Sandstone and concealed	25	330	
Red shale	10	340	
Sandy shale	30	370	
Sandstone, massive, Morgantown to 840' A. T. B.	45	415	230'

The following section was measured by Teets, from a high point near head of Cool Spring Branch, about two miles S. 50° West from Legg P. O., westward to head of Cool Spring Branch, Poca district:

Section 1.8 Miles Southwest of Legg P. O., Poca District.

	Thickness Feet.	Total Feet.	
Monongahela Series (159')			
Concealed	40	40	
Sandstone, massive	50	90	
Sandy shale	10	100	
Sandstone, massive, coarse	30	130	
Concealed	25	155	
Coal blossom, Pittsburgh	4	159	159'
Conemaugh Series (201')			
Sandy shale and concealed	41	200	
Sandstone	30	230	
Concealed	10	240	
Sandstone	45	285	
Red shale	15	300	
Sandy shale	10	310	
Sandstone, massive, medium coarse	45	355	
Limy shale to 735' A. T. B.	5	360	201'

The following section was measured by Krebs with aneroid, descending from a high point southwestward to Wills creek of Little Sandy creek, 4 miles northeast of Clendennin, Big Sandy district:

Section 4 Miles Northeast of Clendennin, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (175')			
Sandy shale and sandstone	20	20	
Red, limy shale	25	45	
Sandy shale and sandstone	55	100	
Red shale	5	105	
Sandstone, massive, Pittsburgh	70	175	175'
Conemaugh Series (580')			
Sandy shale and sandstone	60	235	
Red shale	5	240	
Sandy shale and sandstone	135	375	
Fire clay and slate (Elk Lick coal horizon)	5	380	
Sandy shale and sandstone	20	400	
Red shale	15	415	
Sandstone, massive, coarse	10	425	
Sandy shale and concealed to top of Rucker well, continuing with the record of said well. Elev. 820' A. T. L.	30	455	
Drift	32	487	
Red rock	128	615	
Slate	40	655	
Sand	60	715	
Slate	40	755	580'
Allegheny-Pottsville Series (1275')			
Sand	150	905	
Slate	20	925	
Sand and slate	150	1075	
Sand	30	1105	
Coal, Winifrede	4	1109	
Sand	56	1165	
Slate	350	1515	
Salt sand	390	1905	
Slate	50	1955	
Sand, Maxton	75	2030	1275'
Mississippian (247')			
Mauch Chunk (61')			
Little lime	30	2060	
Shells	31	2091	61'
Big lime, Greenbrier	121	2212	121'
Pocono Sandstones (65')			
Slate	1	2213	
Sand, Keener	12	2225	
Sand, Big Injun	45	2270	
Slate	7	2277	65'

The following section was measured by the writer with aneroid, descending from the summit of a high hill to Tupper creek, 2 miles southwest of Sissonville, Poca district:

Section 2 Miles Southwest of Sissonville, Poca District.

	Thickness Feet.	Total Feet.	
Monongahela Series (66')			
Sandstone, massive, Pittsburgh	60	60	
Slate	2	62	
Coal, Pittsburgh	4	66	66'
Conemaugh Series (164')			
Sandy shale and concealed	34	100	
Sandstone	20	120	
Fire clay (Little Pittsburgh coal horizon)	1	121	
Sandstone	21	142	
Red shale	11	153	
Limestone, dark, Clarksburg	1	154	
Red and sandy shale	16	170	
Sandstone, shaly	9	179	
Red shale, nodular	17	196	
Sandstone (Vis.) to 670' A. T. B.	34	230	164'

The following section was measured by Krebs with hand level, descending westward from top of a high hill at Floyd Copenhaver's, 2 miles north of Copenhaver, Elk district:

Section 2 Miles North of Copenhaver at Floyd Copenhaver's, Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (400')			
Sandstone, massive, Lower Pittsburgh	50	50	
Red shale	25	75	
Sandstone, conglomeratic, Connellsville	60	135	
Sandy shale	3	138	
Red shale	31	169	
Sandy shale	5	174	
Red shale, limestone nodules	41	215	
Sandstone, massive, Morgantown	50	265	
Sandy shale	5	270	
Limestone, dark, impure. Elk Lick	3	273	
Sandy shale and sandstone	17	290	
Red, limy shale	2	292	
Sandy shale	28	320	
Red shale	45	365	
Sandstone	11	376	
Limestone, dark, Ames	2	378	
Sandy shale	15	393	
Concealed	5	398	
Coal blossom, Bakerstown	2	400	400'

The preceding section begins at the base of the Monongahela series and extends to the Bakerstown coal. The Connellsville sandstone is massive and forms rugged cliffs along little Sandy creek. The Lower Pittsburgh sandstone also reaches a thickness of 50 feet and is massive.

The following section begins on a high point in the divide between Grapevine creek and Whiteman branch of Aarons fork of Little Sandy creek, 1.5 miles north, 35° west from Aaron P. O., and descends along the county road southeast to head of Whiteman Branch, as measured by Teets:

Section 1.5 Miles Northwest of Aaron P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (204')			
Concealed	150	150	150'
Conemaugh Series (313')			
Sandy shale	10	160	
Sandstone and concealed	90	250	
Fire clay	2	252	
Sandstone and sandy shale	28	280	
Sandstone, massive	55	335	
Red and sandy shale	10	345	
Fire clay	2	347	
Red shale	28	375	
Sandstone, massive, Grafton	30	405	
Sandstone, sandy shale, and concealed	58	463	313'

The following section was measured with hand level by Krebs, descending southeast from a high point of the hill at Hunt, to Little Sandy creek:

Section at Hunt, Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (204')			
Sandstone, sandy shale and concealed	81	81	
Red shale	50	131	
Sandstone, massive, Pittsburgh (?)	73	204	204'
Conemaugh Series (352')			
Red shale	10	214	
Sandstone 12 / Sandy shale 7 — Lower Pittsburgh	19	233	
Red shale	55	288	
Sandy shale	6	294	
Sandstone, massive, Connellsville	44	338	
Dark, red shale	51	389	
Sandstone, massive, Morgantown	40	429	
Red shale	15	444	

	Thickness Feet.	Total Feet.	
Sandstone	14	458	
Sandy shale	14	472	
Sandstone	25	497	
Sandy shale	5	502	
Sandstone, Saltsburg?	44	546	
Concealed to 650' A. T. L.	10	556	352'

Adding 50 feet for the dip of the strata, the interval between the base of the Pittsburgh and base of the Saltsburg sandstone would be 392 feet.

The following section was measured by Teets from a high point at the head of Bullskin Branch of Little Sandy creek, southwestward to a point on Aarons Fork of Little Sandy creek 0.5 mile southeast of Aarons P. O.:

Section 0.5 Mile Southeast of Aarons P. O.

	Thickness Feet.	Total Feet.	
Monongahela Series (30')			
Concealed	30	30	30'
Conemaugh Series (440')			
Sandstone and concealed	50	80	
Sandy shale	10	90	
Sandstone and concealed	35	125	
Fire clay	2	127	
Sandstone, massive, medium coarse, Connellsville	38	165	
Sandy shale	15	180	
Red shale	5	185	
Sandy shale and sandstone	47	232	
Sandstone, massive	43	375	
Sandy shale	15	290	
Dark, red shale	25	315	
Fire clay	2	317	
Red shale	8	325	
Sandstone, massive, medium coarse	75	400	
Limestone, Two-Mile	1	401	
Red and sandy shale	39	440	
Sandstone and concealed to 690' A. T. L.	30	470	440'

The above section gives the interval between the Pittsburgh coal and the Two Mile limestone as 370 feet.

The following section was measured by Teets from a high point in Poca and Elk districts line on the divide between Legg fork of Tupper creek and Fivemile fork of Cooper creek, descending along a private road southeast of the head of Fivemile Fork of Cooper creek:

Section 2 Miles Southeast of Legg P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (85')			
Concealed	80	80	
Coal, good, Pittsburgh	5	85	85'
Conemaugh Series (285')			
Sandy shale and concealed	35	120	
Sandstone, medium coarse grained	60	180	
Sandy shale	10	190	
Sandstone, massive, coarse	20	210	
Sandy shale	20	230	
Red shale	5	235	
Red and sandy shale, mixed	25	260	
Sandstone, massive, Connellsville	10	270	
Red shale	10	280	
Sandstone	15	295	
Red shale	10	305	
Sandy and red shale	35	340	
Sandstone, Morgantown, to 780' A. T. L.	30	370	285'

The following section was measured by Teets from a low gap in divide between Goose creek and Aarons Fork, also in Elk and Poca districts, along the county road, southward to head of Aarons Fork:

Section 1.3 Miles Southwest of Blundon P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (102')			
Concealed	100	100	
Coal blossom, Pittsburgh	2	102	102'
Conemaugh Series (141')			
Sandstone and concealed	68	170	
Fire clay	2	172	
Sandstone, massive, coarse, Connellsville	68	240	
Coal, impure..2'-0" / Coal, soft .....1'-0" — Little Clarksburg	3	243	141'

This section gives the interval between the Pittsburgh and Little Clarksburg coals as 141 feet.

The following section was measured by Krebs along road, descending southward from a high hill between Big Fork of Little Sandy and Wills creek, into Wills creek, 2.5 miles northwest of Falling Rock station:

Section 2.5 Miles Northwest of Falling Rock Station, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (80')			
Red shale	25	25	
Sandstone, massive, Pittsburgh	55	80	80'

PLATE IX.—Blue Creek Oil Field at Blue Creek.

	Thickness Feet.	Total Feet.	
Conemaugh Series (315')			
Sandy shale and concealed	50	130	
Red and sandy shale	25	155	
Sandstone, massive, Connellsville, Upper..	70	225	
Sandy shale	5	230	
Sandstone, massive, Connellsville, Lower	50	280	
Red and sandy shale	80	360	
Sandy shale and sandstone, to 795' A. T. L.	35	395	315'

The above section gives the interval between the base of the Pittsburgh and Lower Connellsville sandstones as 200 feet.

The following section was measured with aneroid by Krebs, descending into Riley Branch of Elk river, 3 miles northeast of Blue creek, Big Sandy district:

Section 3 Miles Northeast of Blue Creek, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (40')			
Sandstone, massive, Pittsburgh	40	40	40'
Conemaugh Series (391')			
Red shale	10	50	
Sandstone, Little Pittsburgh	40	90	
Sandstone and sandy shale	110	200	
Sandstone, massive, Morgantown	75	275	
Red and sandy shale	22	297	
Sandy shale	4	301	
Red shale	2	303	
Dark limestone, impure, Elk Lick.....	2	305	
Red and sandy shale	50	355	
Sandy shale	25	380	
Sandstone, massive...25 Slate ..... 2 } Saltsburg ... Sandstone, coarse 23	50	430	
Coal blossom, Bakerstown. Elev. 721' L..	1	431	391'

Adding 25 feet for the dip of the strata, the interval between the base of the Pittsburgh sandstone and Bakerstown coal will be 416 feet at this place.

The following section was measured by Krebs with aneroid from a high knob southward to Left Hand Fork of Leatherwood creek, 2 miles southwest of Clendenin, Big Sandy district:

Section 2 Miles Southwest of Clendenin, Big Sandy District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (458')			
Sandstone, massive	50	50	
Red, limy shale	30	80	
Sandstone	25	105	
Red and sandy shale	45	150	
Sandstone, massive, Morgantown	50	200	
Red, limy shale	50	250	
Red and sandy shale	10	260	
Sandstone, flaggy, Grafton	40	300	
Red shale	5	305	
Sandstone, shelly	30	335	
Red shale	5	340	
Sandstone and sandy shale	10	350	
Red and sandy shale	10	360	
Sandstone	20	380	
Sandstone and sandy shale	10	390	
Sandstone, friable, Mahoning	68	458	458'
Allegheny Series (97')			
Fire clay, Upper Freeport	2	460	
Sandstone and concealed	40	500	
Sandstone	45	545	
Coal blossom, No. 5 Block	5	550	
Sandstone to 765' A. T. L.	5	555	97'

The foregoing section begins near the base of the Monongahela series.

The following section was measured by Teets with aneroid from a high point south of Rich creek, southwestward to Elk river at a point 0.3 mile below mouth of Rich creek, and about 1.8 miles westward of Falling Rock station:

Section 1.8 Miles Southwest of Falling Rock Station, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (75')			
Sandstone, massive, coarse, Pittsburgh	75	75	75'
Conemaugh Series (510')			
Red shale	3	78	
Sandstone and sandy shale	22	100	
Red shale	3	103	
Sandstone, fine grained	47	150	
Dark red, limy shale with streaks of sandy shale	30	180	
Sandstone and sandy shale	20	200	
Red, limy shale	5	205	
Sandstone and concealed	28	233	
Red shale	2	235	
Sandstone, medium coarse, Morgantown	35	270	

PLATE X.—Blue Creek Oil Field, ½ mile south of Blue Creek, showing the Chloe Copenhaver wells.

	Thickness Feet.	Total Feet.	
Red shale	5	275	
Sandstone, massive, coarse, Morgantown..	35	310	
Sandy shale	10	320	
Sandstone, medium coarse, massive, Grafton	55	375	
Red and sandy shale	5	380	
Sandstone, massive, medium coarse, Saltsburg	30	410	
Sandy shale	15	425	
Sandstone, coarse, massive, Buffalo	75	500	
Sandy shale and concealed	10	510	
Sandstone, massive, rather coarse, Upper Mahoning	30	540	
Fire clay, Mahoning	...	...	
Sandstone, massive, medium coarse, Lower Mahoning	45	585	510′
Allegheny Series (90′)			
Sandy shale and concealed	10	595	
Sandstone, massive, medium coarse	30	625	
Sandy shale	10	635	
Sandstone, massive, coarse, East Lynn, to 620′ A. T. B.	40	675	90′

Adding 50 feet for the dip of the strata to 510 feet, will make thickness of the Conemaugh series 560 feet at this point.

The following section begins on a high point capped by a massive cliff of the Pittsburgh sandstone, just northwest of mouth of Doctors creek of Big Sandy, and descends to the level of Big Sandy at mouth of Doctors creek, as measured by Teets:

Section 1.8 Miles Northwest of Clendenin, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (60′)			
Sandstone, massive, conglomeratic, Pittsburgh	60	60	60′
Conemaugh Series (550′)			
Sandy shale and concealed	65	125	
Sandstone, massive, medium coarse, Connellsville	65	190	
Concealed	20	210	
Dark red shale and concealed	60	270	
Sandstone and concealed	50	320	
Red shale and concealed	30	350	
Sandstone	30	380	
Red and sandy shale	10	390	
Sandstone, Grafton	30	420	
Red and sandy shale	30	450	
Sandstone, Saltsburg	20	470	
Red shale	5	475	

	Thickness Feet.	Total Feet.	
Sandstone, massive, medium coarse, Buffalo	65	540	
Sandy shale	10	550	
Sandstone, Mahoning, to 625' A. T. L.	60	610	550'

The above section shows the thickness of the Conemaugh series to be 550 feet.

The following section starts on a ridge about 2 miles northwest of Hunt P. O. and descends along a private road, down a small Branch of Pocatalico Fork of Little Sandy 1.5 miles above Hunt P. O., as measured by Teets:

Section 1.5 Miles Northwest of Hunt P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (135')			
Red shale	20	20	
Sandstone	20	40	
Red shale	3	43	
Sandy shale and sandstone	37	80	
Red shale	5	85	
Sandstone, massive, coarse, Pittsburgh	50	135	135'
Conemaugh Series (280')			
Sandy shale	10	145	
Sandstone, massive, Lower Pittsburgh	35	180	
Sandy shale	10	190	
Sandstone, massive, coarse	50	240	
Fire clay	3	243	
Sandstone, massive	37	280	
Sandy shale	5	285	
Limy, red shale	5	290	
Sandstone and concealed	40	330	
Red shale	8	338	
Sandy shale	12	350	
Sandstone, massive, Grafton, to 705' A. T. B.	65	415	280'

In this section the Pittsburgh and Grafton sandstones form massive cliffs and the customary red shales appear to be displaced with sandstones and sandy shales.

The following section begins on point of a spur northwest of mouth of Buckner fork of Little Sandy creek and descends southwest down hill to mouth of Buckner, as measured by Teets:

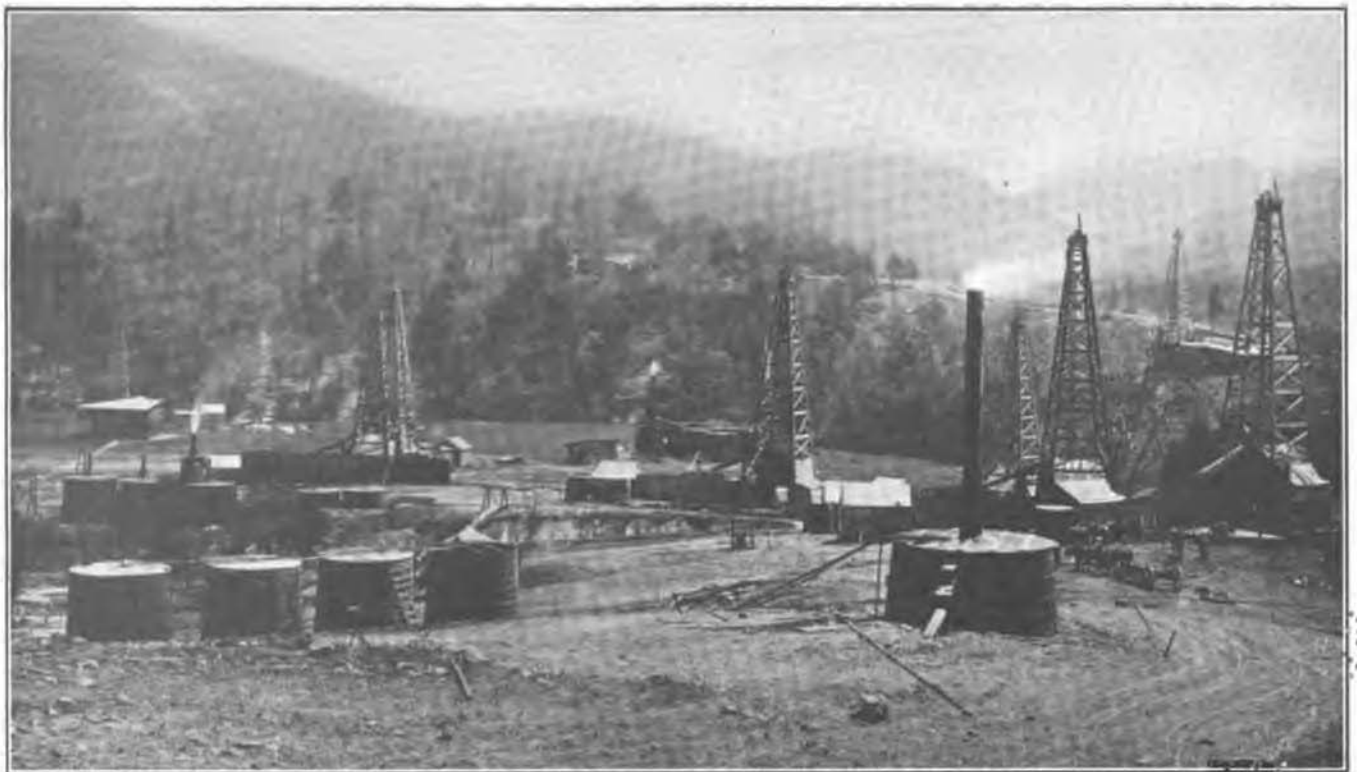

PLATE XI.—Scene in Blue Creek Oil Field, showing Conemaugh Series.

Section 3 Miles Northeast of Hunt P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (70')			
Sandy shale and concealed	20	20	
Sandstone, massive, conglomeratic, micaceous, friable, Pittsburgh	50	70	70'
Conemaugh Series (345')			
Sandy shale	5	75	
Sandstone, Lower Pittsburgh	45	120	
Sandy shale	15	135	
Sandstone, massive, medium coarse, Connellsville	65	200	
Sandy shale and sandstone	65	265	
Concealed	30	295	
Red shale	30	325	
Sandstone	20	345	
Red shale	5	350	
Sandstone, Grafton	15	365	
Red shale with limestone nodules	10	375	
Sandy shale	5	380	
Sandstone	15	395	
Concealed	5	400	
Limestone, nodular and concealed to creek level, 690' A. T. B.	15	415	345'

The following section was measured by Teets with aneroid, descending southwest from a high point 0.5 mile northwest of the mouth of Jordan creek, along a new road to mouth of said creek, 1 mile north of Falling Rock station:

Section 1 Mile North of Falling Rock Station, Big Sandy District.

	Thickness Feet.	Total Feet.
Conemaugh Series (525')		
Concealed	30	30
Sandstone, massive, coarse, Pittsburgh	40	70
Sandy shale	20	90
Sandstone, massive, coarse, friable, Lower Pittsburgh	40	130
Concealed	30	160
Red shale	20	180
Fire clay	2	182
Sandy shale and sandstone, Morgantown	78	260
Red shale	10	270
Sandstone	35	305
Sandy shale and concealed	15	320
Red shale	15	335
Limestone, Upper Ames	2	337
Red shale	13	350
Sandstone, massive	30	380
Red, limy shale	10	390

	Thickness Feet.	Total Feet.	
Fire clay	2	392	
Sandstone, massive, Saltsburg	48	440	
Fire clay, Bakerstown coal horizon	2	442	
Sandy shale	8	450	
Sandstone, massive, Buffalo	50	500	
Coal blossom, Brush Creek	2	502	
Sandstone, massive, Mahoning	23	525	525′
Coal blossom, Upper Freeport	3	528	
Sandstone, massive, to 615′ A. T. B.	17	545	

Adding 50 feet for the dip of the strata will make the thickness of the Conemaugh series at this point 575 feet.

The following section begins on a high knob to southeast of mouth of Little Laurel run of Big Sandy creek, Roane county, and descends northward to the mouth of Little Laurel run, 2.5 miles east of Osbornes Mills, Geary district, Roane county, as measured by Teets:

Section 2.5 Miles East of Osbornes Mills, Geary District, Roane County.

Conemaugh Series (510′)		Thickness Feet.	Total Feet.
Red shale and concealed		15	15
Sandstone and concealed		25	40
Red shale and concealed		15	55
Sandstone, Connellsville		20	75
Red and sandy shale		15	90
Sandstone		30	120
Red shale and concealed		15	135
Sandstone, massive and concealed		60	195
Red shale		5	200
Sandstone		15	215
Red and sandy shale		25	240
Sandstone and sandy shale		25	265
Red shale		20	285
Sandstone and sandy shale		25	310
Sandstone, flaggy, Saltsburg		35	345
Red shale, light color		5	350
Sandy shale		8	358
Fire clay, Bakerstown coal horizon		2	360
Sandy shale and concealed		40	400
Sandstone, massive, medium coarse ....30 Sandstone and concealed..10 Sandstone, massive, medium coarse 27	Buffalo.	67	467
Coal, slaty.....0′-6″ Coal, splinty ...2′-6″	Brush Creek Coal..	3	470

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PLATE XII.—J. E. Brown Well No. 1 (on fire), Blue Creek Field.

		Thickness Feet.	Total Feet.	
Sandstone, massive cliff rock .....35 Sandy shale 5	Mahoning	40	510	510′
Allegheny Series (20′)				
Sandstone and concealed		20	530	20′

The following section was measured by Teets from a point 2 miles northeast of Hunt P. O., eastward down hill to a point on Little Sandy:

Section 2 Miles Northeast of Hunt P. O., Elk District.

	Thickness Feet.	Total Feet.	
Monongahela Series (50′)			
Concealed	20	20	
Sandstone and concealed, Pittsburgh:.....	30	50	50′
Conemaugh Series (360′)			
Sandy shale and concealed	15	65	
Sandstone	35	100	
Concealed	20	120	
Sandstone, massive, coarse, Connellsville	50	170	
Concealed	20	190	
Coal (abandoned opening), Little Clarksburg, reported 3 feet	3	193	
Concealed	47	240	
Red shale and sandstone, (Morgantown), mostly sandstone	100	340	
Sandstone, Grafton	20	360	
Red shale	10	370	
Sandstone	30	400	
Concealed to Little Sandy creek at 690′ A. T. B.	10	410	360′

The above section gives the interval between the base of the Pittsburgh sandstone and Little Clarksburg coal as 143 feet.

The following section was measured by Teets from a high point on the Big Sandy and Elk district line one mile south of mouth of Rich creek, northward to C. & C. Railroad level 0.2 mile west of mouth of Rich creek and 1.9 miles southwest of Falling Rock station:

Section 1.9 Miles Southwest of Falling Rock Station, Big Sandy District.

	Thickness Feet.	Total Feet.	
Monongahela Series (75′)			
Sandstone, massive, coarse, Pittsburgh...	75	75	75′
Conemaugh Series (465′)			
Red shale	3	78	

	Thickness Feet.	Total Feet.	
Sandy shale and concealed	22	100	
Red shale	3	103	
Sandstone, fine grained	47	150	
Red and sandy shale	30	180	
Sandstone and sandy shale	20	200	
Red, limy shale	5	205	
Sandstone and concealed	28	233	
Red shale	2	235	
Sandstone, medium, coarse grained, massive	35	270	
Red shale	5	275	
Sandstone, massive, coarse	35	310	
Sandy shale	10	320	
Sandstone, massive, medium coarse	55	375	
Red and sandy shale	5	380	
Sandstone, massive, medium coarse, Saltsburg	30	410	
Sandy shale	15	425	
Sandstone, massive, coarse, Buffalo	75	500	
Sandy shale and concealed	10	510	
Sandstone, massive, medium coarse, Mahoning	30	540	465′
Allegheny Series (120′)			
Fire clay, Upper Freeport coal horizon	3	543	
Sandstone, massive, medium coarse	37	580	
Sandy shale and concealed	10	590	
Sandstone, massive, medium coarse	30	620	
Sandy shale	10	630	
Sandstone, massive, coarse, (East Lynn) to C. & C. R. R. level, 620′ A. T. B.	30	660	120′

Making a correction of 75 feet for the dip of the strata, the thickness of the Conemaugh series, at this point, will be 540 feet.

Another section was measured by Teets from a high point one-half mile northwest of Blue Creek, southwestward to Blue Creek P. O.:

Blue Creek Section, Elk District.

		Thickness Feet.	Total Feet.
Conemaugh Series (565′)			
Sandstone, sandy shale and concealed		25	25
Sandstone, massive, medium coarse, quarry rock ..... 25 Sandstone, medium coarse friable 40	Connellsville	65	90
Sandy shale		10	100
Red shale		10	110
Sandstone, massive and concealed		30	140
Fire clay		3	143
Sandstone and concealed, Morgantown		32	175

PLATE XIII(a).—Jordan Creek Oil Field, Big Sandy District.

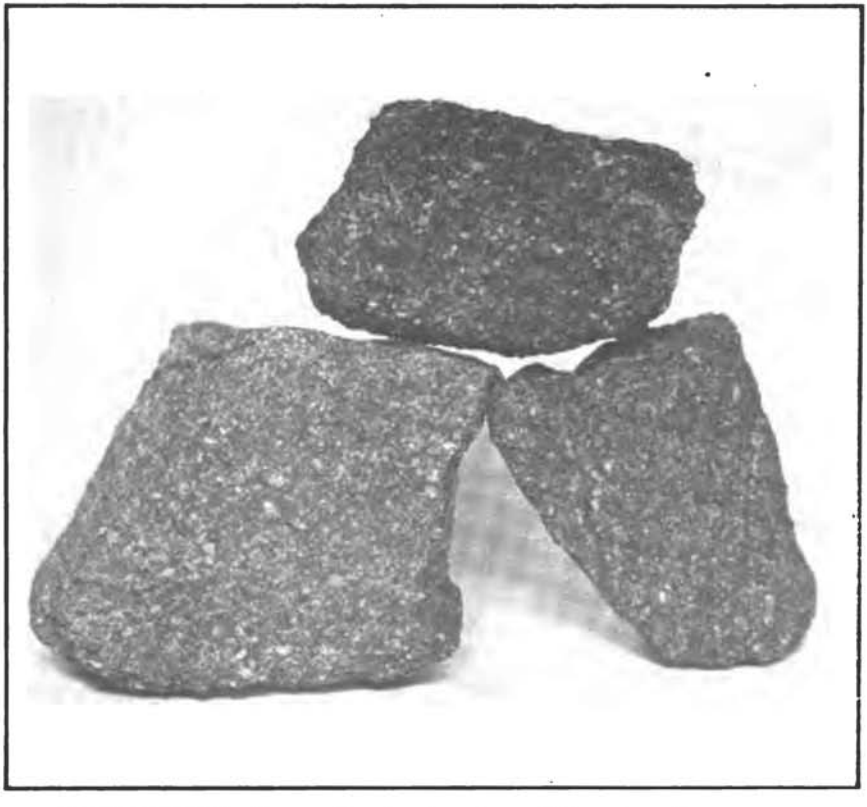

PLATE XIII(b).—Squaw Sand taken from Chloe Copenhaver well No. 2, Blue Creek Oil Field, one-half size.

	Thickness Feet.	Total Feet.	
Red shale, dark	15	190	
Limy shale and fire clay	5	195	
Sandy shale and concealed	25	220	
Red shale	3	223	
Sandy shale	7	230	
Sandstone, massive, medium coarse, Grafton	65	295	
Sandy shale	10	305	
Fire clay	3	308	
Red, limy shale	12	320	
Limestone, impure	2	322	
Sandstone, massive, medium coarse	33	355	
Limestone, hard, blue	1	356	
Limy shale	4	360	
Red shale	10	370	
Limestone, impure, nodular	3	373	
Red and sandy shale	32	405	
Sandstone, Saltsburg (?)	20	425	
Fire clay, dark, Bakerstown coal horizon.	2	427	
Sandy shale	8	435	
Sandstone, massive, with one small break above the center to creek level. (Buffalo-Mahoning). 600′ A. T. L.	130	565	565′

The base of this section contains the Buffalo and Mahoning sandstones, and appears to have very little separating shale, if any, between the two sandstones.

DESCRIPTION OF THE CONEMAUGH FORMATIONS.

The Lower Pittsburgh Sandstone.

From 5 to 15 feet under the Pittsburgh coal there frequently occurs a massive, pebbly sandstone from 10 to 50 feet thick that has been designated the **Lower Pittsburgh sandstone** from its association with the coal bed of that name. This sandstone crops in the northern part of Kanawha county in massive cliffs from 10 to 50 feet in thickness and is coarse grained, buff and often pebbly. It forms massive cliffs along the waters of Two Mile, Tuppers and Rocky Fork creeks in Union district, and along Grapevine, Goose and Leatherwood creeks in Poca district. In Elk district along the headwaters of Coopers and Little Sandy creeks, the **Lower Pittsburgh sandstone** forms cliffs ranging in thickness from 30 to 50 feet. These cliffs make steep bluffs near the tops of the ridges

and high points, and the hills north of Elk river are frequently capped with this sandstone, in massive cliffs or bowlders.

In Big Sandy district, the Lower Pittsburgh sandstone forms cliffs along Big Sandy creek and its tributaries, and caps the highest points near the mouth of Jordan creek and Sand run, north of Elk river, and south of Elk this sandstone caps the highest points between Left Fork and Leatherwood creeks and Burke Branch, two miles southeast of Clendenin, where it is 40 feet thick and pebbly, at an elevation of 1320′ A. T. B. The Lower Pittsburgh sandstone also caps several of the high hills between Falling Rock creek and Blue creek. This sandstone is frequently quarried and used for building purposes by the farmers, in constructing house foundations and chimneys, and seems to resist exposure very well. It is frequently replaced with red limy shale.

The Little Pittsburgh Coal.

From 30 to 65 feet under the Pittsburgh coal there frequently occurs a thin bed of coal that has been designated the **Little Pittsburgh coal** by Dr. I. C. White, from its association with the overlying bed.

In Jefferson district, on the head of Smith creek, John Mason once mined this coal and reported it to Teets as 23 inches thick, with slate roof and fireclay floor.

In Union district, on the head of Sigman Fork of Tuppers creek, along the county road, Teets measured the following section:

Coal, Pittsburgh—	Feet.	Inches.
Sandstone and concealed	63	0
Coal blossom, Little Pittsburgh	2	0
Fire clay, 960′ A. T. B.		

The Little Pittsburgh coal was once mined by M. L. Carnes 1.5 miles north of Blue Creek station, where the following section was measured:

Coal Blossom, Pittsburgh—	Feet.	Inches.
Sandy shale and concealed	60	0
Coal, Little Pittsburgh	2	0
Slate floor, 990′ A. T. B.		

The Little Pittsburgh Limestone.

The stratum of limestone that occurs from 50 to 60 feet under the Pittsburgh coal and from 1 to 5 feet below the Little Pittsburgh coal has been designated by Dr. I. C. White as the Lower Pittsburgh limestone. Traces of this limestone were found on the divide between Falling Rock and Blue creek, where it occurs in a gray, impure stratum 1 foot 6 inches thick, coming about 60 feet below the base of the Pittsburgh sandstone.

The Connellsville Sandstone.

From 75 to 90 feet beneath the Pittsburgh coal there occurs a coarse, buff, brownish, massive sandstone from 20 to 50 feet thick of great economic importance. This stratum rises from the bed of the Youghiogheny river at Connellsville, Pa., from which locality it was first named and described by J. J. Stevenson. For a detailed description of this bed in West Virginia, the reader is referred to Vol. II, pages 247-248, of the W. Va. Geological Survey, 1903.

This sandstone crops in the northern part of Kanawha county and is quarried at several places by the farmers for house foundations, and chimneys, and appears to stand the weather very well, and it makes an excellent building stone.

A quarry in this bed has also been opened on Little Sandy creek, near mouth of Buckner Fork, where it attains a thickness of 40 feet, and is buff or brownish. This sandstone forms massive cliffs along Little Sandy creek and its tributaries in Elk district, also along Pocatalico river and its tributaries in Poca district.

Along the headwaters of Cooper and Two Mile creeks the Connellsville sandstone forms massive cliffs in places and at other places it is displaced by red and sandy shale.

In Union district the **Connellsville sandstone** forms cliffs 30 to 40 feet high along the Kanawha river between Lock Seven and Two Mile, and above Tylers creek.

The Little Clarksburg Coal.

From 110 to 150 feet under the Pittsburgh coal and from 1 to 15 feet under the Connellsville sandstone, there occurs a

very persistent coal bed in the northern part of West Virginia that has been named the Little Clarksburg coal by Dr. I. C. White, in Vol. II, pages 248-249, W. Va. Geological Survey, 1903, where he gives a detailed description of this bed, to which the reader is referred.

In Kanawha county, the Little Clarksburg coal is thin and of little economic importance. It is usually represented by black slate and fireclay; however, the bed has been mined in several places.

In Jefferson district, on the head of Browns creek, just east of the Putnam-Kanawha county line, Samuel Casdorph made an opening in this coal, in which he reports 2 feet of impure coal, and there the following section was measured:

	Thickness Feet.	Total Feet.
Sandstone, massive, Lower Pittsburgh	60	60
Sandy and red shale and concealed	30	90
Sandy shale	10	100
Coal blossom, reported 2 feet, Little Clarksburg	2	102
Sandy and red shale	60	162
Sandstone, Morgantown	45	207
Sandy shale	10	217
Coal blossom, Elk Lick, 860′ A. T. B.	2	219

The above section shows the **Little Clarksburg** coal coming 115 feet above the **Elk Lick coal.**

In **Union district,** the **Little Clarksburg coal** has been prospected on the head of Fisher Branch of Rocky Fork, and the following section was measured there by Teets:

	Feet.	Inches.
Sandstone, massive	15	0
Sandy shale	3	0
Coal, hard, Clarksburg	0	11
Fire clay floor, 765′ A. T. B.		

This coal occurs here 140 feet below the base of the Pittsburgh coal.

Passing north to the head of Dutch Fork of Pocatalico river, where the Little Clarksburg coal was once mined, the following section was measured:

	Thickness Feet.	Total Feet.
Coal blossom, Pittsburgh		
Concealed	70	70
Red shale	35	105
Sandy shale and sandstone	40	145
Coal, impure, Little Clarksburg. 680′ A. T. B.	2	147

Near the head of Raccoon creek of Pocatalico river, 1.6 miles west of Blundon P. O., B. J. Harding once mined the **Little Clarksburg coal** and reports that he found 30 inches of impure coal.

Passing over to the head of Leatherwood creek we find A. J. Shafer is mining the Little Clarksburg coal 1.2 miles southwest of Blundon P. O., where the following section was measured:

Section of A. J. Shafer's Mine.

	Thickness Feet.	Total Feet.
Sandstone roof		
Coal, impure	2	2
Coal, soft, good	1	3
Slate floor, 880′ A. T. L.		

A sample was collected for analysis from which Prof. Hite reports the following results:

	Per cent.
Moisture	1.55
Volatile Matter	38.57
Fixed Carbon	47.39
Ash	12.49
Total	100.00
Sulphur	3.39
Phosphorus	.010

The above analysis indicates a coal high in ash and sulphur, but a fair fuel coal nevertheless.

The Little Clarksburg coal has also been mined by John Price, on the head of Blundon, about 1 mile northeast of the Shafer mine, but the opening has fallen shut and been abandoned; Elev. 880′ A. T. B.

In Elk district, on head of Aaron Fork of Little Sandy creek, just across the divide from the Shafer mine, A. L. Koontz is mining the Little Clarksburg coal, where the following section was measured:

Section of A. L. Koontz' Coal Opening.

	Feet.	Inches.
Sandstone, massive		
Coal, impure	2	0
Coal, good	1	10
Fire clay floor, 880' A. T. B.		

One mile south of east from Hunt P. O. on a branch of Little Sandy creek, R. H. Canterberry once mined this coal. The opening had fallen in when visited by the writer, hence no section could be measured. The owner reported about 30 inches of coal, fair with slate roof and fireclay floor, at 890' A. T. B.

The Clarksburg Limestone.

From 10 to 35 feet under the Connellsville sandstone there occurs a calcareous stratum which has been designated by Dr. I. C. White as the **Clarksburg limestone,** owing to its development near Clarksburg, W. Va., where a description was first printed in Vol. II, pages 249-250, West Virginia Geological Survey, 1903.

The Clarksburg limestone occurs in Kanawha county as an impure, reddish stratum from 1 to 2 feet thick, and of very little economic value. The following section taken along a road descending into Tyler creek, 3 miles north of Dunbar, Union district, gives its general geologic horizon:

	Thickness Feet.	Total Feet.
Sandstone, buff, Connellsville	24	24
Red shale	20	44
Sandy shale	10	54
Limestone, reddish, impure, Clarksburg, 785' A. T. B...	2	56

Another section showing this horizon near Fairview church, Union district, was taken as follows:

	Thickness Feet.	Total Feet.
Sandstone, buff, brownish, Connellsville	20	20
Red shale	15	35
Limestone, impure, reddish, 740' A. T. L.....	2	37

The Morgantown Sandstone.

At 10 to 30 feet below the Clarksburg limestone there occurs a massive, buff or brownish sandstone, ranging in thick-

ness from 20 to 60 feet, that has been designated the **Morgantown sandstone** by Dr. J. J. Stevenson, from the city of that name in Monongalia county, at which place it has been quarried extensively for building purposes.

In Kanawha county the Morgantown sandstone forms cliffs along the north side of Kanawha river from Sattes to mouth of Two Mile creek, ranging in thickness from 20 to 35 feet.

Mr. F. A. Sattes once operated a quarry in this ledge for building stones and grindstones at Sattes on the K. & M. Railway, Union district. Also, stone was quarried here for building Lock No. 7 on the Kanawha river and for bridge abutments for the K. & M. Railway. The top of the sandstone here comes 271 feet below the base of the Pittsburgh sandstone, or Pittsburgh coal horizon.

The rock is bluish and often light brown or buff in color. It is fine grained and frequently has a granular texture. The following section was measured near Sattes:

	Thickness Feet.	Total Feet.
Red and blue shales	14	14
Sandstone, bluish	10	24
Sandstone, brownish	14	38
Sandstone, buff	5	43
Dark fire clay, 690' A. T. B.	3	46

The Morgantown sandstone rises out of Pocatalico river at Raymond City, where the last abutment of the highway bridge across the river rests on this ledge. Along Pocatalico, the sandstone remains in the bed of the stream until a short distance below the mouth of Tuppers creek, when the stratum goes under water level.

Along Tuppers creek the Morgantown sandstone gradually rises above the bed; and on Sigman Fork makes massive cliffs 30 to 50 feet high.

This sandstone also forms cliffs along Two Mile, Cooper and Little Sandy creeks, capping the highest hills south of Elk river and along the mouth of Blue creek or Falling Rock. The Morgantown sandstone very seldom makes abrupt cliffs, as the sandstone is quite friable and disintegrates easily. It has been quarried for a building stone in the construction of

chimneys, house and bridge foundations in several parts of the county, but disintegrates too easily to make a good building stone.

The Elk Lick Coal.

From 1 to 15 feet under the Morgantown sandstone there occurs a small impure bed of coal, fairly persistent which has been designated the **Elk Lick coal** by the First Geological Survey of Pennsylvania, from a stream of that name in Somerset county, Pa., along which it crops with a thickness of 4 feet.

In Kanawha county, the Elk Lick coal is thin and of very little economic value.

On a branch of Browns creek, in Jefferson district, A. J. Bryan made a prospect opening into it 1.2 miles west of Lower Falls station, and reports 8 inches of coal at an elevation of 755′ A. T. B. The opening had been closed, so the writer was unable to get a measurement of same.

In Union district, on road leading from Woodward Branch to Kanawha Two Mile creek, the Elk Lick coal crops where the following section was measured by Teets:

	Thickness Feet.
Sandstone, massive, Morgantown	20
Red, limy shale	5
Coal blossom, Elk Lick	1-6″
Red, sandy shale, 775′ A. T. B.	

At the mouth of Wolfpen Branch of Tupper creek, in Union district, near Wallace P. O., the Elk Lick coal crops in the road, where the following section was measured:

(Sandstone, massive.)	Feet.	Inches.
Sandy shale	10	0
Slate	0	6
Coal, good	0	4
Fire clay, 683′ A. T. L.		

This coal opening occurs 230 feet beneath the Pittsburgh coal.

Passing to the headwaters of Wolfpen Branch of Tupper creek, 1.5 miles southeast of Wallace, W. M. Haynes prospected for the Elk Lick coal and reports the following section:

(Slate roof.)	Feet.	Inches.
Coal, impure	1	6
Fire clay floor, 705' A. T. L.		

The opening was closed with earth and the writer was unable to get a section of same. The coal comes 210 feet below the Pittsburgh bed.

The Elk Lick Limestone.

From 15 to 40 feet under the Elk Lick coal and 210 to 225 feet below the Pittsburgh coal bed, there is a widely persistent limestone in southwestern Pennsylvania and northern and southern West Virginia that has been named by the Messrs. Platt the **Elk Lick limestone.** The limestone is of fresh or brackish water origin, like all those in the series above it, and contains no marine fossils. It is fairly pure and will burn into a good quality of lime for building and fertilizing purposes. In Kanawha county this limestone crops in ledges from 1 to 2 feet thick, being gray in color and fairly pure and hard. It is often displaced with red limy shale.

In Jefferson district, in the road leading northeast across the divide between Browns creek and Left Fork of Tackett creek, the Elk Lick limestone occurs 15 feet under a massive cliff (Morgantown sandstone) and is 2 feet thick, at an elevation 750 feet.

In Union district, 2 miles east of Guthrie P. O., on Rich Branch of Two Mile creek, the following section was measured:

(Sandstone.)	Feet.	Inches.
Concealed	5	0
Red and sandy shale	10	0
Limestone, yellow, Elk Lick	1	6
Limy shale and concealed, 690' A. T. B.	3	0

This section comes 225 feet under the Pittsburgh coal.

In Poca district, on Grape Vine creek, just above the mouth of Boardtree Branch, the following section was measured by Teets:

(Sandy shale.)	Feet.	Inches.
Limestone, impure, Elk Lick	3	0
Red and sandy shale	4	0
Sandstone, visible	6	0
Elev. 725' A. T. B.		

The preceding sections represent the general character of the Elk Lick limestone in Kanawha county, showing that it is of very little commercial or economic value.

The Birmingham Shale.

Directly under the Elk Lick limestone there often occurs 5 to 40 feet of variegated and sandy shales that have been named by Dr. J. J. Stevenson the **Birmingham shales,** from their exposure at the former town of that name on the south side of the Monongahela river, Pittsburgh, Pa., where they have a jointed appearance and slide badly on the almost vertical face of the hill.

In Kanawha county these shales are often replaced with layers of sandstone and sandy shales, but are present quite frequently. They are mined by the Standard Brick Company, 2½ miles north of Elk river, near Charleston, where the shale is transported by buckets on an aerial tramway from the mine to the plant, a distance of more than 3000 feet. The following is a section of the pit:

	Thickness Feet.	Total Feet.
Sandstone and sandy shale, Morgantown	...	...
Red shale	30	30
Yellow shale	3	33
Sandstone	5	38
Yellow and hard shales	3	41
Sandstone	6	47
Blue shale, bottom of pit	8	55
Sandstone and concealed	71	126
Limestone, impure, Two-Mile	2	128

The Grafton Sandstone.

At from 5 to 30 feet below the Elk Lick limestone there often occurs a great massive, coarse and sometimes pebbly sandstone, ranging in thickness from 10 to 60 feet, that has been designated by Dr. I. C. White the **Grafton Sandstone,** from its outcrop near the summit of the hills at the town of that name in Taylor county. This stratum often replaces the Birmingham shale almost entirely. Its thickness, character and relative position in the rock column in Kanawha county are exhibited in the sections given on preceding pages.

In Kanawha county this sandstone crops along Coal river and forms massive cliffs. At Tornado P. O. it appears in a cliff 20 to 25 feet high and is medium coarse in grain, gray in color on fresh fracture, but weathering to a buff color. It makes an excellent building stone at this place, as is attested by Jas. M. Gray's residence at Tornado, built from this sandstone, just after the Civil War and does not yet show any disintegrating tendency.

The Grafton sandstone crops in cliffs from 20 to 30 feet high along Kanawha Two Mile and near the head of Cooper creek and its branches.

On Narrow Branch, north of Blue creek in Elk district, this sandstone forms cliffs 60 feet high, being coarse and often pebbly. Also on Riley branch and Jordans creek massive, rugged cliffs mark the horizon of the Grafton sandstone. No quarries were observed in this ledge, although it is more than probable that the sandstone will make an excellent building stone.

Two Mile Limestones. (The Ames Limestone.)

At from 5 to 30 feet under the Grafton sandstone and from 275 to 325 feet under the Pittsburgh coal there occurs a calcareous and very fossiliferous stratum in northern West Virginia that was long ago named by Professor Andrews in the Ohio State Geological reports the **Ames limestone.** The horizon of the Ames limestone appears to be represented in Kanawha county by two fresh or brackish water limestones 20 feet apart and called the **Two Mile limestones** by Dr. I. C. White in his Volume II, W. Va. Geol. Survey, page 239, containing Spirorbis and other non-marine fossils.

No marine fossils were observed in these limestones within the Kanawha county area.

In Jefferson district this limestone crops along Coal river and its tributaries and is 1 to 4 feet thick. On Browns creek, about 1 mile east of the Kanawha-Putnam county line, the following section was measured:

Browns Creek Section.

	Thickness Feet.	Total Feet.
Sandy shale and concealed	10	10
Limestone, gray, Two-Mile	1	11
Red and sandy shale	7	18
Coal blossom, Harlem	3	21
Sandstone, bluish gray and concealed	17	38
Limestone, Two-Mile	2	40
Red shale and concealed	10	50

Elevation of lower limestone, 655' A. T. B.

A sample of the lower one was collected here and Mr. Krak reports the following analysis of same:

	Per cent.
Silica Si 0_2)	4.46
Ferric Iron	1.83
Alumina (Al_20_3)	0.18
Calcium Carbonate (Ca $C0_3$)	90.58
Magnesia Mg 0)	2.50
Phosphoric Acid (P_20_5)	0.30
Loss on ignition	0.12
Total	99.97

The above analysis shows a limestone of considerable purity and suitable for fertilizing purposes, as well as for general use as a mortar, etc.

The lower stratum at this point is 350 feet below the base of the Pittsburgh coal.

The lower limestone is usually the thicker stratum, and on Smith creek, 3.5 miles southeast of St. Albans, this bed shows 2 feet of bluish gray limestone at an elevation of 648' A. T. L.

The following section measured by Teets along Edgewood Drive, leading from Charleston to the Country Club on Edgewood, shows both the Upper and Lower Two Mile limestones in Charleston district:

Section on Edgewood Drive.

	Thickness Feet.	Total Feet.
Sandstone, buff, Grafton	20	20
Red shale	9	29
Limestone, nodular, impure, Two-Mile	1	30
Red shale	18	48
Limestone, bluish gray, Two-Mile, 770' A. T.	2	50
Red limy shale, Pittsburgh reds	30	80
Sandstone, massive, Saltsburg	30	110

On Kanawha Two Mile creek, near the mouth of Sugar creek, the following section was measured:

Two Mile Section.

	Thickness Feet.	Total Feet.
Sandstone	...	...
Sandy shale	3	3
Limestone, impure	2	5
Red and sandy shale	30	35
Limestone	2	37
Sandy shale and concealed	...	...

The elevation of the lower limestone is 620′ A. T. B., and comes 360 feet under the base of the Pittsburgh coal. Another section 1.5 miles northeast of Guthrie P. O., at mouth of Eden Fork of Two Mile, shows the Upper Two Mile limestone 4 feet thick, as follows:

Section 1.5 Miles Northeast of Guthrie P. O.

	Thickness Feet.	Total Feet.
Sandstone, massive	20	20
Sandy shale and concealed	4	24
Limestone, gray, hard, 640′ A. T.	4	28

On Right Fork of Two Mile creek, 2 miles northeast of Guthrie P. O., in a drain on side of road, the following section is exposed:

	Thickness Feet.	Total Feet.
Sandstone, shelly	5	5
Limestone, impure, 650′ A. T. B.	5	10
Red, limy shale, variegated	5	15

At the mouth of Copen Branch of Right Fork of Two Mile creek, 2.3 miles west of Mink P. O., the following section appears in bed of branch:

	Thickness Feet.	Total Feet.
Shale and concealed	10	10
Limestone, Two-Mile, 697′ A. T. L.	2	12
Limy shale	...	...

On Two Mile Fork of Cooper creek, 1 mile west of its mouth, the Upper Two Mile limestone crops in bed of the branch, and shows the following section:

	Thickness Feet.	Total Feet.
Red shale	4	4
Limestone, impure, 730′ A. T. B.	2	6

One mile north of Hunt P. O., on Pocatalico Fork of Little Sandy creek, the following section was measured:

	Thickness Feet.	Total Feet.
Sandstone, massive, Grafton	30	30
Red shale	4	34
Limestone, nodular, dark gray	3	37
Red shale to 690′ A. T. L.	5	42

South of Elk river, in the public road leading up the hill to the southeast from Falling Rock station, this limestone horizon crops and shows the following section:

	Thickness Feet.	Total Feet.
Sandstone	21	21
Sandy shale	2	23
Limestone, 865′ A. T. B.	2	25
Sandy shale	14	39

One mile west of the Clay-Kanawha county line, on the head of Booker hollow, in road leading from said hollow to Morris creek, and one mile northeast of Apgah P. O., one of these limestones crops, being 3 feet thick, nodular, and impure, at an elevation of 1300′ A. T. B.

On Coal river, 1.2 miles southwest of St. Albans and 0.3 mile northeast of Lower Falls, the following section was measured by Teets in railroad cut:

Section 0.3 Mile Northeast of Lower Falls.

	Thickness Feet.	Total Feet.
Red and sandy shale	10	10
Limestone	2	12
Red and sandy shale	23	35
Limy shale	3	38
Sandstone and red shale	22	60
Limestone	2	62
Sandstone and red shale	15	77
Limestone, impure	3	80
Sandstone, massive	6	86
Coal blossom, 600′ A. T. L.	1	87

Up Coal river one mile further, both the upper and lower of these limestones appear below the Elk Lick coal at 100 and 150 feet, respectively.

The upper limestone at this point is impure, mostly nodular and about 3 feet in thickness. The lower one is 2 feet thick, hard, bluish in color, making a ledge that may be traced along the hillside by its bowlders.

This limestone horizon crops out along Coal river almost continuously from St. Albans until it reaches the tops of the highest hills in the southwestern part of Kanawha county.

One mile northwest of Fuquay station, on Mahone branch, a fine exposure of the Two Mile limestone may be seen cropping. It is 3 feet thick, bluish gray, hard, and massive at 685′ A. T. B.

On the divide between Little Brier creek and Trace Fork of Davis creek, 1 mile east of Alumville, the following section was measured, showing one of these limestones:

	Thickness Feet.	Total Feet.
Red shale	...	...
Limestone, impure	5	5
Red shale	35	40
Sandstone, Saltsburg, to 1110′ A. T. B.		

The Harlem Coal.

From 1 foot to 10 feet below the Lower Ames limestone there occurs in the northwestern part of the State a very persistent coal that was named the **Crinoidal coal** by the First Geological Survey of Pennsylvania, and later the **Friendsville coal** by G. C. Martin, of the Maryland Geological Survey. This coal was first designated the **Harlem coal** by Dr. J. S. Newberry, from a town of that name in Carroll county, Ohio, where it was worked in shafts, and according to J. J. Stevenson, this name has priority in geological nomenclature, and this is the name used in the West Virginia Geological Reports. In Kanawha county this coal is only fairly persistent and has very little economic value. This coal has been mined on Browns creek, in Jefferson district, for local use, in several places.

The following section shows a measurement made at the Hester White mine, just opposite the mouth of Angel Fork of Browns creek:

	Thickness Feet.	Total Feet.
Sandstone, massive	15	15
Shale	2	17
Limestone	1	18
Slate	2	20
Coal, good, Harlem, 675' A. T. B.	2	2°

A sample was collected and Mr. J. B. Krak reports the following analysis:

	Per cent.
Moisture	2.46
Volatile Matter	34.11
Fixed Carbon	56.34
Ash	7.09
Total	100.00
Sulphur	5.29
Phosphorus	0.016

In most parts of Kanawha county this coal is usually represented by a thin layer of dark slate and impure coal.

The Ewing Limestone Horizon.

From 1 to 10 feet below the Harlem coal there often occurs a calcareous stratum of 1 to 5 feet thick that has been named the **Ewing limestone** by the Ohio geologists. It appears to be of fresh or brackish water origin, since it seldom contains any marine fossils in West Virginia. In Kanawha county this limestone was observed at several localities, as shown in the preceding sections.

The Pittsburgh Red Shale.

Immediately below the Ewing limestone in northern West Virginia there occurs a soft, red or purple, and variegated shale, ranging in thickness from 30 to 100 feet, thas has been designated the **Pittsburgh Red Shale,** from its crop near the city of that name in Pennsylvania. This band of reds is nearly always recorded by the drillers for oil and gas, and is usually called by them the "Big Red Cave," on account of its caving tendencies when penetrated by the drill. Great care has to be exercised in drilling through these reds to avoid losing the drilling tools. In Kanawha county these reds are often replaced with sandy shale and sandstone. These shales crop

over a large portion of the county, north of Elk river, and in Elk and Big Sandy districts south of Elk river.

They also occur in Jefferson, Washington and the western portion of Loudon districts, and often contain limestone nodules. In Malden district this Pittsburgh red shale caps the highest hills east of Campbells creek.

The Saltsburg Sandstone.

The lower portion of the Pittsburgh red shale is quite frequently replaced by a massive sandstone, medium coarse, sometimes pebbly, that has been named the Saltsburg sandstone by Dr. J. J. Stevenson, from the town by that name in Pennsylvania, where it attains a thickness of 100 feet.

In Kanawha county this sandstone ranges in thickness from 20 to 40 feet, and often forms massive cliffs.

Sections of this bed have been given in the general sections and in the sections of the Conemaugh series, showing its place in the geologic column. This stratum has been quarried for constructing house foundations and chimneys by the farmers, and appears to make a fairly good building stone.

The Bakerstown Coal.

At from 1 to 10 feet below the Saltsburg sandstone and from 75 to 100 feet under the Ames limestone horizon there occurs a thin bed of coal that has been designated the **Bakerstown coal** by Dr. I. C. White, from a town by that name in Allegheny county, Pa., near where it has been mined. In Kanawha county this coal has been mined but is of little commercial value.

In Jefferson district, on Browns creek, 0.8 mile northwest of mouth of Angel Fork, Mr. C. J. White once mined this coal, where the following section was measured:

		Thickness Feet.	Total Feet.
Sandstone, massive, Saltsburg		15	15
Slate		10	25
Coal 0'-5"			
Slate, bituminous 0'-4"			
Coal 0'-4"	Bakerstown	2-8"	27-8"
Slate, bituminous 0'-4"			
Coal 1'-3"			
Fire clay, 605' A. T. B.			

Further down Browns creek, at the mouth of Angel Fork, about 18 inches of the Bakerstown coal appears in the bank of the county road at an elevation of 605′ A. T. L., and 75 feet under the Ames limestone horizon.

In Washington district 0.3 mile north of Lincoln station, in the railroad cut of the Coal River Branch of the C. & O. Ry. the following section is exposed:

	Thickness Feet.
Sandstone, massive, Saltsburg	20
Coal, Bakerstown, 620′ A. T. B.	1-0″
Sandy shale	3-3″
Limestone, Pine Creek	1-2″
Sandstone and concealed to bed of Coal river	...

On Fry Branch of Coal river, about one mile northeast of Tornado P. O., and about 800 feet east of the river, Mr. Bibbian Howell once mined the Bakerstown coal and reports 18 inches of fairly good coal with slate roof and fireclay floor. The opening had fallen in, and no measurement was taken of the coal, by the writer. This coal is 205 feet beneath the Elk Lick coal, and 400 feet below the Pittsburgh coal.

The Bakerstown coal occurs near the summits of the hills on the Southside in Charleston. Opposite the mouth of Elk river, the Bakerstown coal appears in the county road leading from the Kanawha river across to Sugar Camp Branch of Davis creek, at elevation of 800′ A. T. B., showing in the crop about 2 feet thick, impure and 60 feet under the red shale. This coal was also encountered in the cellar in Mr. F. M. Staunton's country home, on the high point northeast of the south end of the bridge, across Kanawha river, at an elevation of 860′ A. T. B., and reported to be 2 feet thick.

The Bakerstown coal was once opened on Kanawha Two Mile creek, where it occurs under 20 feet of flaggy sandstone at an elevation of 592′ A. T. L. and shows 2 feet of impure coal.

On Magazine Branch of Elk river, about ½ mile northeast of the Country Club House on Edgewood, the Bakerstown coal appears, 2 feet thick beneath a flaggy sandstone at an elevation of 700′ A. T. B.

Near the head of Newhouse Branch of Elk river, 2.1 miles northeast of Two Mile station, the Bakerstown coal was once

mined, and reported as 2 feet of impure coal at an elevation of 800′ A. T. B. The opening has been abandoned, and no measurement could be taken.

Near the head of Lick Branch of Little Sandy creek, about 2 miles northwest of Copenhaver P. O., W. F. Copenhaver once opened the Bakerstown coal, at an elevation of 700′ A. T. L., but he only found 14 inches of coal, so abandoned same.

The Bakerstown coal crops at several places along the water of Little Sandy creek, but is thin and of no commercial or economic value.

Bakerstown Fire Clay.

Below the Bakerstown coal is a persistent bed of fire clay from 2 to 6 feet thick, in some portions of Kanawha county, which the writer has designated the Bakerstown Fire Clay from its proximity to the coal of that name. This fire clay is grayish white, soft and plastic, and would possibly make good fire brick.

Pine Creek Limestone.

From 3 to 5 feet under the Bakerstown coal there frequently occurs a bluish gray limestone, often fossiliferous, that was designated by Dr. I. C. White **the Pine Creek Limestone** in the second Geological Survey of Pennsylvania, from a locality in Allegheny county, where it comes 120 feet below the Ames Limestone.

In Kanawha county the Pine Creek limestone occurs along Coal river and is 1 to 2 feet in thickness.

The following section, taken in the railroad cut of the Coal River Branch of the C. & O. Ry., 0.3 mile north of Lincoln, illustrates its occurrence.

	Thickness Feet.
Coal, Bakerstown	1-0″
Fire clay	3-0″
Limestone, gray, impure	1-2″

No marine fossils were found in this limestone. Frequently the limestone bed is replaced by a massive sandstone (Buffalo).

Buffalo Sandstone.

At 15 to 30 feet below the Bakerstown coal in northern West Virginia and western Pennsylvania there occurs a coarse, grayish white, pebbly and massive sandstone, varying in thickness from 25 to 80 feet, that has been designated the Buffalo sandstone by Dr. I. C. White from a stream of that name in eastern Butler county, Pennsylvania. At its type locality, according to Dr. White, the stratum is very massive and conglomeratic, its top being 175 feet above the base of the Conemaugh series, and its bottom 125 feet above the same datum.

In Kanawha county the Buffalo sandstone is often massive and coarse, forming cliffs from 20 to 80 feet in thickness. This sandstone comes out of Kanawha river near Dunbar, and at Kanawha Two Mile creek, crops on side of turnpike, at an elevation of 608′ A. T. L. The Saltsburg and Buffalo sandstones are often separated by only a small stratum of shale, as is shown in the sandstone quarry of Crawford & Ashby one mile west of Spring Hill, where the following section is exposed:

	Thickness Feet.	Total Feet.
Limestone, gray, nodular, Ames	1	1
Red shale	18	19
Sandstone, massive, coarse, Saltsburg-Buffalo	100	119

Considerable stone has been quarried here and used in buildings and constructing bridge and railroad masonry, much being crushed for railroad ballast and concrete.

The Buffalo sandstone crops along the waters of Davis creek, and rises until at the head of Sugar Camp Branch it caps the hills.

The following section was taken at Pleasant Oak schoolhouse, descending west along the county roads:

	Thickness Feet.	Total Feet.
Fire clay, Bakerstown coal horizon	2	2
Sandstone, friable, coarse grained	73	75
Coal blossom, Brush creek	1	76

The Buffalo sandstone forms massive, pebbly cliffs along Elk river, from its mouth to the eastern boundary of Kanawha county at the mouth of Porters Creek.

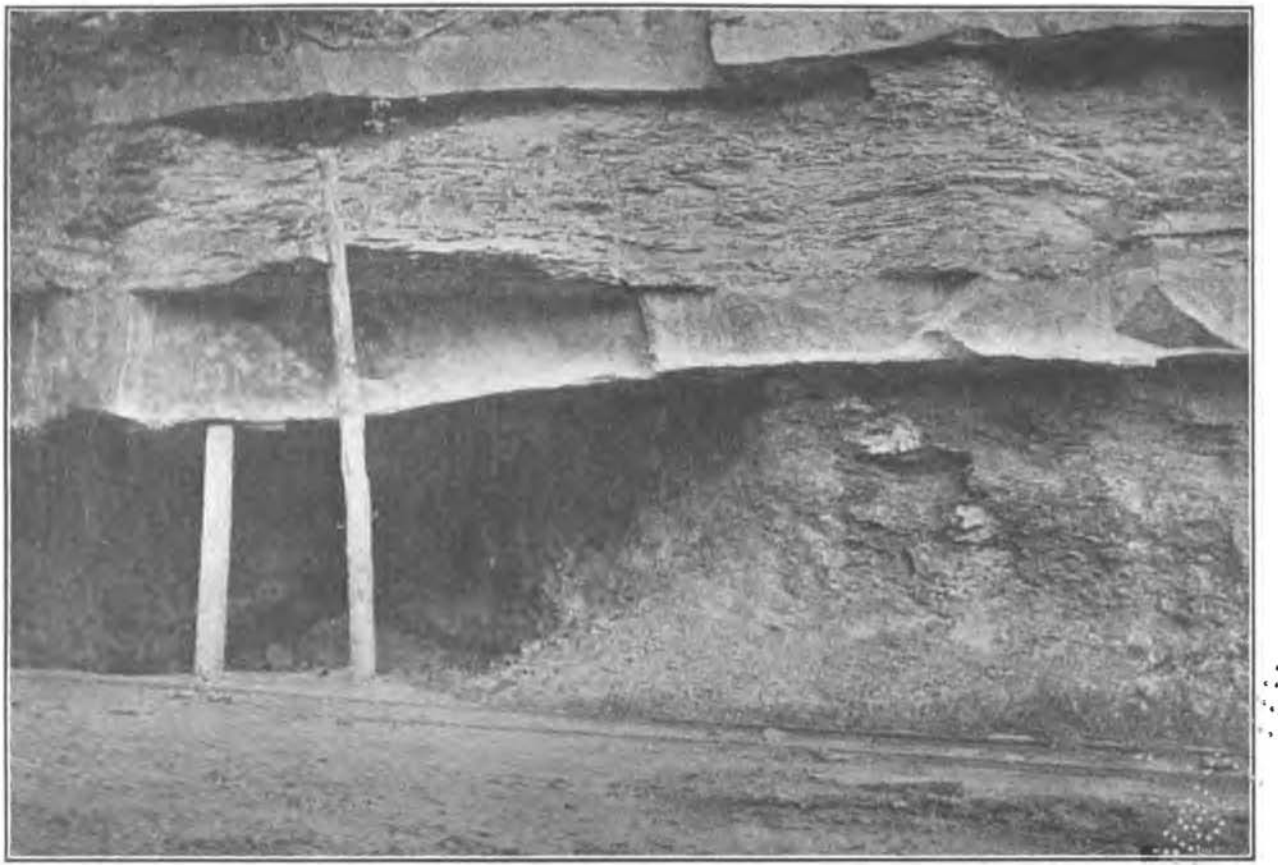

PLATE XIV.—Kanawha and New River Brick Company clay mine at Kanawha Two Mile, showing Elk Fire Clay.

The following section, 2 miles northeast of King Station, Big Sandy district, shows the Buffalo sandstone in connection with the Ames limestone horizon:

	Thickness Feet.	Total Feet.
Limestone, gray, nodular, Ames horizon	1	1
Limy shale	4	5
Red shale	5	10
Sandstone and concealed	40	50
Red shale	10	60
Sandy shale and concealed, Saltsburg	35	95
Sandstone, massive, pebbly, Buffalo	40	135
Sandy shale and concealed	25	160
Sandstone, massive	90	250
Coal blossom, (No. 5 ?)	3	253

The Buffalo and Mahoning sandstones often almost merge together, as shown in the following section at the mouth of Sand Run, in Big Sandy district:

	Thickness Feet.	Total Feet.
Red shale	50	50
Sandstone, massive, Saltsburg	30	80
Sandy shale	25	105
Sandstone, massive, (Buffalo-Mahoning), visible	85	190

The Buffalo sandstone is a very good building stone, easily quarried, hard in texture, and has a bluish gray or yellowish gray color.

The **Brush Creek Limestone** of western Pennsylvania does not appear to be present in Kanawha county, and the underlying **Brush Creek coal** is usually represented by black slate only instead of coal.

Elk Fire Clay.

At a varying interval below the Buffalo sandstone there appears a bed of reddish variegated fire clay that has been designated the **Elk fire clay,** from Elk river, near Charleston, where it is mined and burned into fire brick, on the south side of Elk near the mouth of Elk Two Mile creek and at Charleston, by the West Virginia Clay Products Company, and by the Kanawha Brick Company.

The following section was taken at the mine of the Kanawha Brick Company, on the south side of Elk river:

Section 1.3 Miles Northeast of Charleston, Charleston District, at Mine of Kanawha Brick Company.

	Thickness Feet.	Total Feet.	
Conemaugh Series (275')			
Sandstone, massive, Buffalo	60	60	
Red and sandy shale	30	90	
Sandy shale and concealed	50	140	
Blue shale	10	150	
Shale and sandstone	10	160	
Blue shale	10	170	
Elk fire clay	6	176	
Sandy shale and concealed	49	225	
Sandstone, friable, coarse, Mahoning	50	275	275'
Allegheny Series (106')			
Sandy shale and concealed	45	320	
Sandstone, massive, East Lynn	60	380	
Coal blossom, No. 5 Block	1	381	106'
Kanawha Series (69')			
Sandstone, massive, medium coarse to C. & C. R. R. track, Homewood. Elev. 600' A. T. B.	69	450	69'

At a point one-third mile further up Elk river, The West Virginia Clay Products Company has exposed the following section at its mine:

Section 1.6 Miles Northeast of Charleston, at Mine of West Virginia Clay Products Company.

	Thickness Feet.	Total Feet.
Sandstone, massive and concealed, Buffalo	50	50
Fire clay, white, poor quality	6	56
Sandstone	8	64
Yellowish shale	4	68
Blue shale	7	75
Sandstone	1	76
Gray shale	5	81
Sand	1	82
Blue shale	2	84
Elk fire clay, good, to 775' A. T.	7	91
Concealed	25	116

This clay was once mined near the mouth of the Kanawha Two Mile Creek by the Kanawha and New River Fire Brick Company, on the east side of the Sissonville road, where the following section was measured:

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PLATE XV.—Saltsburg-Buffalo Sandstone quarry at Spring Hill.

VIENNA SECESSION

Section at Mouth of Kanawha Two Mile Creek, Charleston District.

	Thickness Feet.	Total Feet.
Red shale and concealed	44	44
Limestone	1	45
Sandstone	20	65
Red shale	10	75
Sandstone	30	105
Red shale	10	115
Sandy shale	20	135
Red shale	15	150
Sandy shale	50	200
Red shale	15	215
Sandstone and sandy shale, Grafton	38	253
Limestone, nodular, impure, (Two-Mile)	2	255
Red shale	15	270
Sandy shale	25	295
Sandstone, Saltsburg	15	310
Sandy shale and concealed	10	320
Sandstone, massive, Buffalo	36	356
Blue shale	1	357
Fire clay shale, variegated	12	369
Elk fire clay	5	374
Concealed to creek, 575' A. T. B.	16	390

This clay is also found on the other creek valleys near Charleston, and on Ferry Branch on the south side of the Kanawha river, opposite the mouth of Elk river, where the clay is exposed along the road leading from Kanawha river to Sugar Camp creek of Davis creek, and is about 10 feet thick, 120 feet under the Ames limestone horizon.

The fire clays will be discussed more in detail in a succeeding chapter of this volume.

The Mahoning Sandstone.

At a varying interval (5 to 25 feet) below the **Brush Creek coal** and at the base of the Conemaugh series there occurs a great, grayish white, coarse, pebbly and massive rock that has been named the **Mahoning sandstone.** Sometimes it is separated into divisions called the Upper and Lower Mahoning. The interval between frequently holds a coal also called Mahoning. The Upper Mahoning is usually more massive and thicker that the Lower. This stratum has produced oil in eastern Greene county, Pennsylvania, on Dunkard creek, from which stream it has also received the name **Dunkard sand**

by the oil fraternity. Quite frequently it is erroneously called the Second Cow Run sand.

The sandstone caps the hills in the eastern and southern part of Kanawha county, and extends into Fayette, Boone, Raleigh, Logan and Mingo counties. It is hard and frequently pebbly on the top of these eastern summits, and reaches a height of 1500 feet above the level of the valley floors.

In Kanawha county the Mahoning sandstone is occasionally a continuation of the lower sandy beds of the Allegheny series, with no separating slates or shales.

The Mahoning sandstone comes out of the bed of the Kanawha river near Spring Hill, and, rising rapidly, caps the tops of the highest hills on the Fayette-Kanawha county line. The section already given on the preceding pages illustrate the general character of the Mahoning sandstone.

The **Mahoning coal** is of no importance in Kanawha county and is represented only by slate and occasionally thin beds of coal of no commercial value.

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PLATE XVI.—Saltsburg-Buffalo Sandstone quarry at Spring Hill.

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CHAPTER VIII.

THE ALLEGHENY SERIES.

The series of rock strata from the base of the Mahoning sandstone to the top of the Homewood sandstone, has been designated the **Allegheny series** by the geologists of the First Geological Survey of Pennsylvania, because they were first developed and explored along the Allegheny river.

The Allegheny series as exposed in Kanawha county ranges in thickness from 120 to 250 feet. It contains several small seams of coal and one of the most important beds of block coal in the Kanawha coal field, viz.: the **Kittanning,** or **"No. 5 Block"** seam.

In Chapter X a number of sections of the Allegheny series from different parts of the country are published. In addition several scattered sections of these measures as exposed at crop will now be given.

The following section was measured by the writer with aneroid, along road extending southwestward to Davis creek at the mouth of Middle Fork of said creek:

Section at Mouth of Middle Fork of Davis Creek.

	Thickness Feet.	Total Feet.	
Conemaugh Series (279')			
Red limy shale	30	30	
Sandstone, buff, Morgantown	30	60	
Dark, red shale	20	80	
Sandstone, shaly, Grafton	20	100	
Red shale	50	150	
Sandstone, Saltsburg-Buffalo	53	203	
Fire clay, Brush creek coal horizon	2	205	
Sandstone, massive, Mahoning	74	279	279'
Allegheny Series (101')			
Fire clay, Upper Freeport horizon	1	280	
Sandstone, Upper Freeport	38	318	
Fire clay and slate, Lower Freeport horizon	12	330	

	Thickness Feet.	Total Feet.	
Sandstone and concealed (East Lynn)....	45	375	
Slate	2	377	
Coal, No. 5 Block	3	380	
Sandstone, massive, Homewood to 610' A. T. B.	20	400	101'

Adding 35 feet for dip to the above section, shows the thickness of the Allegheny Series 136 feet at this point.

Another section was measured by the writer, with aneroid descending southwestwardly along road to Davis creek at mouth of Sugar Creek Branch, as follows:

Sugar Camp Branch Section, 3 Miles South of Charleston, Loudon District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (90')			
Sandstone and concealed	90	90	90'
Allegheny Series (137')			
Fire clay, Upper Freeport	2	92	
Sandstone, friable	73	165	
Coal blossom, Lower Freeport	2	167	
Sandstone, massive, East Lynn	58	225	
Coal blossom, No. 5 Block	2	227	137'
Kanawha Series (237')			
Sandstone, massive, Homewood	53	280	
Slate	2	282	
Coal blossom	2	284	
Sandstone and concealed (Kanawha Black Flint horizon)	16	300	
Coal, Stockton	3	303	
Sandstone, massive, coarse, Coalburg....	77	380	
Coal blossom, Coalburg	2	382	
Sandstone, Upper Winifrede	60	442	
Coal, Winifrede "Black Band".....	2	444	
Sandstone, Lower Winifrede to Davis creek 675' A. T. B.....	20	464	237'

The above section gives 137 feet as the thickness of the Allegheny series at this locality.

The following section was measured by Teets, descending southward along county road to point on Rays Branch of Davis creek, about ½ mile above mouth of this Branch:

Section 1.5 Miles Southwest of Charleston, Loudon District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (238')			
Red shale and concealed	68	68	
Fire clay	2	70	
Red shale	15	85	
Fire clay and limy shale	10	95	
Sandstone, massive, friable, coarse, Saltsburg-Buffalo	75	170	
Sandy shale	15	185	
Sandstone, massive, Mahoning	53	238	238'
Allegheny Series (117')			
Fire clay, Upper Freeport coal horizon	2	240	
Sandstone and concealed	42	282	
Fire clay	3	285	
Sandstone and concealed	28	313	
Fire clay	2	315	
Sandy shale and concealed, East Lynn	39	354	
Coal blossom, No. 5 Block	1	355	117'
Upper Kanawha Series (77')			
Sandstone, massive, Homewood	73	428	
Kanawha Black Flint	2	430	
Coal blossom, Stockton-Lewiston. (Elev. 670' A. T. B.)	2	432	77'

The following section was measured by Teets from a point just east of the head of Ferry Branch, one mile southwest from Charleston, with the meanders of the county road to the head of Ferry Branch:

Section 1 Mile Southwest of Charleston, Loudon District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (232')			
Concealed	90	90	
Red shale	13	103	
Fire clay	2	105	
Sandy shale, Saltsburg	43	148	
Fire clay	2	150	
Sandstone, conglomeratic, friable, Buffalo.	35	185	
Sandy shale and concealed	24	209	
Coal blossom, Brush Creek	1	210	
Sandstone and sandy shale, Mahoning	22	232	232'
Allegheny Series (138')			
Fire clay, Upper Freeport horizon	3	235	
Sandstone, massive, medium coarse	35	270	
Sandy shale	8	278	
Fire clay, Lower Freeport horizon	2	280	
Sandstone and sandy shale	18	298	
Fire clay	2	300	
Sandy shale	5	305	

	Thickness Feet.	Total Feet.	
Sandstone, massive, gray-buff color, coarse, friable, East Lynn	63	368	
Coal, blossom, No. 5 Block	2	370	138'
Kanawha Series (55')			
Sandstone, massive, medium coarse, Homewood to 600' A. T. B.	55	425	55'

The above section gives the thickness of the Allegheny Series 138 feet.

The following section was measured by Teets with aneroid from a high point on west side of Elk river, just above Magazine Branch, southward down hill to the K. & W. V. railroad track.

Section 2 Miles Northwest from Charleston, Charleston District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (295')			
Sandstone and concealed	45	45	
Sandy shale	5	50	
Sandstone and concealed	45	95	
Sandy shale	10	105	
Sandstone and concealed	60	165	
Sandy shale	20	185	
Sandstone, coarse, Saltsburg	50	235	
Sandy shale	5	240	
Sandstone, massive, coarse, friable, (Buffalo-Mahoning)	55	295	295'
Allegheny Series (101')			
Sandy shale	10	305	
Sandstone, massive, medium coarse	55	360	
Sandy shale	10	370	
Sandstone, massive, East Lynn	25	395	
Coal blossom, No. 5 Block	1	396	101'
Sandstone, massive, medium coarse, Homewood, to railroad track 610' A. T. B.	69	465	

Adding 40 feet for the dip of the strata to the above makes the thickness of the Allegheny series 141 feet at this point.

The following section was measured by Krebs with aneroid, descending southward along the road leading to Elk river from a high point between Mink Shoals run and Newhouse Branch, 3 miles northeast of Charleston, Elk district:

Section 3 Miles Northeast of Charleston, Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (386')			
Sandstone, medium coarse	60	60	
Red shale, limestone nodules	13	73	
Fire clay, Elk Lick coal horizon	2	75	
Sandstone, friable	10	85	
Sandy shale	15	100	
Red shale, limestone nodules	20	120	
Sandstone	28	148	
Red shale	2	150	
Sandstone	20	170	
Red shale	35	205	
Sandy shale and sandstone	9	214	
Red shale, limestone nodules	8	222	
Sandstone ...18 / Sandy shale..11 — Saltsburg	29	251	
Red shale	4	255	
Sandy shale and sandstone ...39 / Sandstone, massive...30 — Buffalo	69	324	
Red fire clay and limestone nodules	10	334	
Sandy shale and sandstone ...34 / Slate ... 2 — Mahoning Sandstone	36	370	
Sandstone	16	386	386'
Allegheny Series 134')			
Fire clay, Upper Freeport coal horizon	2	388	
Concealed	17	405	
Sandstone, massive, Freeport	60	465	
Dark fire clay and shale	2	467	
Sandstone, massive (East Lynn)	50	517	
Coal blossom, No. 5 Block	3	520	134'
Kanawha Series (60')			
Sandstone (Homewood) and concealed to level of Elk river, 555' A. T. B.	60	580	60'

The following section was measured by Teets from a high point 1.5 miles southwest of Big Chimney on west side of Elk river, southeastward to the K. & W. V. railroad track 1.2 miles southwest of Big Chimney:

Section 1.5 Miles Southwest of Big Chimney, Elk District.

	Thickness Feet.	Total Feet.
Conemaugh Series (345')		
Sandstone, massive...10 / Sandy shale ... 5 / Sandstone, massive...35 — Connellsville Sandstone	50	50
Sandy shale and concealed	60	110
Red shale	15	125

	Thickness Feet.	Total Feet.	
Concealed	20	145	
Red shale	10	155	
Sandstone, Grafton	35	190	
Concealed	20	210	
Red shale	30	240	
Sandy shale	15	255	
Red shale	10	265	
Concealed	25	290	
Sandy shale..10 Concealed ...15 } Buffalo Sandy shale..15	40	330	
Sandstone, massive, coarse, Mahoning	15	345	345′
Allegheny Series (155′)			
Sandy shale	5	350	
Sandstone, massive, Freeport	35	385	
Sandy shale	5	390	
Sandstone, massive, ferriferous, East Lynn	80	470	
Coal blossom...2′ Sandstone .....8′ } No. 5 Block Coal blossom...2′	12	482	
Sandstone	16	498	
Fire clay	2	500	155′
Upper Kanawha Series (30′)			
Sandstone and concealed to Kanawha & West Virginia R. R. track 620′ A. T. B..	30	530	

The above section shows that the Allegheny series is thickening some towards the east. The Allegheny series appears to be getting thicker to the south also, as shown in the following section, measured by Teets from a point in the Elk and Malden district line, northward along county road to Mill creek, ½ mile southeast of Villa P. O.:

Section 0.5 Mile Southeast of Villa P. O., Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (203′)			
Sandstone and concealed	42	42	
Red shale	3	45	
Sandstone, massive, coarse	20	65	
Sandy shale	5	70	
Sandstone and concealed, Saltsburg	35	105	
Fire clay, Bakerstown coal	3	108	
Sandstone, flaggy, Buffalo	40	148	
Fire clay, Brush Creek	2	150	
Sandstone, flaggy, Mahoning	53	203	203′
Allegheny Series (202′)			
Fire clay, Upper Freeport coal horizon...	2	205	
Sandstone, coarse, massive	105	310	
Sandy shale	10	320	

	Thickness Feet.	Total Feet.	
Sandstone	20	340	
Sandy shale	10	350	
Sandstone, massive, East Lynn	43	393	
Coal blossom ..2' / Sandstone .....7' / Coal cannel ....3' } No. 5 Block	12	405	202'
Upper Kanawha Series (25')			
Sandstone, massive, Homewood, to 785' A. T. B.	25	430	25'

The following section was measured with aneroid by Krebs, descending southward from a high hill ½ mile east of Putney and joined on to core drill hole No. 1 of Campbells Creek Coal Co. (620 ft.):

Section ½ Mile East of Putney, Malden District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (250')			
Red and sandy shale	40	40	
Sandstone, buff	20	60	
Sandy shale	20	80	
Sandstone, Saltsburg	58	138	
Fire clay, Bakerstown coal horizon	2	140	
Sandstone, Buffalo	33	173	
Fire clay, Brush Creek coal horizon	2	175	
Sandstone, massive, Mahoning	75	250	250'
Allegheny Series (148'-4")			
Fire clay and coal blossom, Upper Freeport	5	255	
Sandy shale and sandstone	25	280	
Dark fire clay and iron ore, Lower Freeport	3	283	
Sandstone .....12 / Sandy shale and sandstone 10	22	305	
Dark fire clay	10	315	
Sandstone and concealed, East Lynn	60	375	
Coal, No. 5 Block	5	380	
Sandy shale and slate to top of Diamond core-drill hole (1235' A. T. B.); thence with core-drill	10	390	
Surface	8-4"	398-4"	398'-4"
Kanawha Series (291'8")			
Sandy shale, Homewood	67-2"	465-6"	
Fire clay	4	469-6"	
Slaty sandrock	8-5"	477-11"	
Slate	2-5"	480-4"	
Coal	0-8"	481	
Fire clay	1-6"	482-6"	
Slate	3-5"	485-11"	
Flint	0-6"	486-5"	

		Thickness Feet.	Total Feet.	
Sandy shale		6-6″	492-11″	
Coal		0-2″	493-1″	
Sandy slate		3	496-1″	
Sandstone		0-6″	496-7″	
Sandy slate		6-10″	503-5″	
Flint, Kanawha Black Flint		6-3″	500-8″	
Sandy slate		7-7″	517-3″	
Coal, Stockton		0-5″	517-8″	
Sandy fire clay		2-6″	520-2″	
Slaty sand rock		4-5″	524-7″	
Sand rock		1-8″	526-3″	
Slaty sand rock		6-4″	532-7″	
Coal ..... 0′- 5″ Parting ..... 0′- 2″ Coal ..... 1′- 0″ Hard coal or bone 0′- 1″ Coal ..... 0′- 6″ Hard coal or bone 0′- 1″ Coal ..... 1′- 2″ Parting ..... 0′-11″ Coal ..... 0′-11″	Coalburg	5-3″	537-10″	
Slaty sand .... 6′- 0″ Sandstone ..... 2′- 6″ Slaty stone ...26′- 6″ Sandstone .....32′- 9″	Winifrede Sandstone	67-9″	605-7″	
Bone, coal and slate, Winifrede		0-7″	606-2″	
Slaty sand		14-4″	620-6″	
Sandy slate stone		2-2″	622-8″	
Coal, Chilton		0-7″	623-3″	
Slaty sand .... 3′- 0″ Sand rock .... 1′- 4″ Slaty sand .... 3′- 0″ Sandstone .....34′- 5″ Sandy slate, dark ..... 3′- 2″ Sandstone .....21′-10″	Campbell's Creek Sandstone	66-9″	690-0″	291-8″

The foregoing section gives some very interesting measurements in regard to the thickness of the Allegheny series. The measurements of the rocks exposed were very carefully made, and the record of the core drill hole was recorded by the Sullivan Machinery Co., which drilled the test hole for the Campbells Creek Coal Company, and hence the thickness of the Allegheny series obtained here is accurate, and appears to be 148.4 feet.

Another section was measured by Krebs, with aneroid descending eastward to Morris Fork of Blue creek, 2 miles west of Pond Fork P. O., Elk district:

Section 2 Miles West of Pond Fork P. O., Elk District.

	Thickness Feet.	Total Feet.	
Allegheny Series (143')			
Sandy shale	10	10	
Dark fire clay and iron ore	2	12	
Limy shale	2	14	
Sandstone, massive	53	67	
Fire clay	3	70	
Sandy shale and sandstone, East Lynn	38	108	
Sandstone	30	138	
Coal 1'-6" / Bone 0'-6" / Coal 3'-0" — No. 5 Block	5	143	143'
Kanawha Series (220')			
Sandstone, massive 50 / Sandstone and concealed 100	150	293	
Kanawha Black Flint	5	298	
Sandy shale	35	333	
Coal blossom, Stockton	5	338	
Sandy shale and concealed	15	353	
Coal, Coalburg (?)	3	356	
Sandstone and concealed to Morris fork 896' A. T. L.	7	363	220'

The following section was measured by Krebs, with aneroid descending from a high hill eastward to Little Ninemile Fork of Campbells creek, 3½ miles northwest of Putney, Malden district, and joined on to Core drill No. 4 (619) drilled by D. G. Courtney:

Section 3½ Miles Northwest of Putney, Malden District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (190')			
Sandstone and concealed	140	140	
Sandstone, Mahoning	50	190	190'
Allegheny Series (195')			
Sandy shale and concealed	190	380	
Coal blossom, No. 5 Block	5	385	195'
Kanawha Series (431')			
Sandstone and concealed, Homewood	80	465	
Kanawha Black Flint	5	470	
Sandstone and concealed to top of core-drill hole put down by D. G. Courtney. Elev. 910' A. T. B.	240	710	
Surface	5	715	
Slaty sandstone	4-6"	719-6"	
Sandstone	2	721-6"	
Sandy slate	15-11"	737-5"	
Gray lime	2-7"	740	
Slaty sandstone	22-2"	762-2"	

	Thickness Feet.	Total Feet.	
Slate	0-1"	762-3"	
Slaty sandstone	2-9"	765	
Slate	0-2"	765-2"	
Sandy slate	1-1"	766-3"	
Slate	0-1"	766-4"	
Sandy slate	0-6"	766-10"	
Sandstone and coal mixed	0-6"	767-4"	
Sandstone	0-6"	767-10"	
Sandy slate	9-6"	777-4"	
Coal, Cedar Grove	0-9"	778-1"	
Fire clay	1	779-1"	
Slate	3-5"	782-6"	
Sand rock	4-6"	787	
Slaty sand rock	2-6"	789-6"	
Slate	1-6"	791	
Coal, Peerless	0-6"	791-6"	
Slaty sand rock	1-6"	793	
Sand rock	1-6"	794-6"	
Gray sandy limestone	4-4"	798-10"	
Slaty sand rock	11-4"	810-2"	
Slate	2-4"	812-6"	
Coal .....1'-10" / Slate parting .....1'- 2" / Coal .....0'- 6" — No. 2 Gas Campbells Creek.	3-6"	816	431'

The following section was measured by Krebs with aneroid, descending southwestward from a high hill, 2 miles northeast from Spangler P. O., Elk district:

Section 2 Miles Northeast of Spangler P. O., Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh-Allegheny Series (330')			
Sandstone, massive, Morgantown	70	70	
Red and sandy shale	40	110	
Sandstone, massive	55	165	
Red and sandy shale	25	190	
Sandstone and concealed	60	250	
Sandy shale and concealed	20	270	
Sandstone, massive, Mahoning	60	330	330'
Allegheny Series (200')			
Sandy shale and concealed	10	340	
Sandstone and concealed	45	385	
Sandstone, massive	45	430	
Sandy shale	5	435	
Sandstone and concealed, East Lynn	90	525	
Sandy shale and fire clay, No. 5 Block coal horizon	5	530	200'
Kanawha Series (165')			
Sandstone and concealed	160	690	
Kanawha Black Flint	5	695	165'

The above section shows the thickness of the Allegheny Series to be 200 feet at this point and thickening slightly eastward.

The following section was measured by Teets from a high point one mile south of Rutledge P. O. and ½ mile east of Valley Branch, northwest down hill along private road to Valley Branch, 1 mile south of Rutledge P. O.:

Section 1 Mile South of Rutledge P. O., Malden District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (235')			
Sandstone and concealed	55	55	
Red and sandy shale	20	75	
Sandstone	20	95	
Red and sandy shale	15	110	
Sandstone and concealed, Saltsburg	35	145	
Sandy shale and sandstone, Buffalo	40	185	
Sandstone, massive, medium coarse, Mahoning	50	235	235'
Allegheny Series (140')			
Sandy shale	10	245	
Sandstone and concealed	70	315	
Sandy shale	10	325	
Sandstone, massive, medium coarse, East Lynn	40	365	
Sandy shale	10	375	140'
Kanawha Series (90')			
Sandstone, massive, coarse, Homewood	60	435	
Kanawha Black Flint	3	438	
Sandstone	12	450	
Coal, Stockton-Lewiston	1	451	
Sandstone to 750' A. T. B.	14	465	90'

Another section was measured by Teets from a point about one mile north of Villa P. O. and ¾ mile southwest of Indian creek, descending northward to Indian creek:

Section 1 Mile North of Villa P. O., Elk District.

	Thickness Feet.	Total Feet.
Conemaugh Series (270')		
Sandy shale and concealed	15	15
Red shale	5	20
Sandstone, massive, medium coarse	20	40
Red shale	5	45
Sandstone, fine grained, flaggy	45	90
Red and sandy shale	10	100
Sandstone, sandy shale and concealed	50	150
Sandstone, Buffalo	40	190

		Thickness Feet.	Total Feet.	
Sandy shale		15	205	
Sandstone, fine grained..35 Sandy shale and sandstone 30	Mahoning..	65	270	270'
Allegheny Series (152'-5")				
Sandstone, massive, coarse		100	370	
Slaty shale, dark		3	373	
Sandstone, massive		42	415	
Shale		3 1-6	418 1-6	
Coal, block .....2'-11" Fire clay .....0'- 4" Coal .....0'- 5" Shale .....0'- 5" Coal, visible .....0'- 3"	No. 5 Block	4 1-6	422½	152'-5"

The following section begins on a high point in the divide between Barren Branch and Broad Run of Elk river and descends to head of Broad Run, as measured by Teets:

Section 2 Miles North of Queen Shoals, Big Sandy District.

		Thickness Feet.	Total Feet.	
Conemaugh Series (310')				
Concealed and sandy shale		20	20	
Sandstone and sandy shale		55	75	
Red and sandy shale		10	85	
Sandstone, friable at base, fine grained and flaggy at top		40	125	
Red shale		5	130	
Concealed		15	145	
Sandstone, massive, friable, Saltsburg....		45	190	
Sandy shale		15	205	
Sandstone and sandy shale, Buffalo.....		65	270	
Fire clay, Brush Creek coal horizon.....		3	273	
Sandstone, massive...17 Sandstone and concealed 20	Mahoning	37	310	310'
Allegheny Series (185')				
Sandy shale and concealed		120	430	
Sandstone, massive. East Lynn		60	490	
Coal blossom, No. 5 Block		5	495	185'
Kanawha Series (60')				
Sandstone, Homewood		60	555	60'

The following was measured from the top of a high hill on the divide between Morris creek about 2 miles southeast of Clendenin, descending northward along the county road to the head of Burks Branch:

Section 2 Miles Southwest of Clendenin, Big Sandy District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (248')			
Concealed	82	82	
Limestone, nodular	3	85	
Sandstone	15	100	
Red and sandy shale with thin layers of sandstone	95	195	
Sandstone, shale and concealed, Mahoning sandstone	53	248	248'
Allegheny Series (192')			
Fire clay, Upper Freeport coal horizon	2	250	
Sandy shale, sandstone and concealed	120	370	
Sandstone, East Lynn	65	435	
Coal blossom, No. 5 Block	5	440	192'

The following section was measured from a high point at extreme head of Two Mile Fork of Falling Rock creek, southwest along private road to Upper Three Mile Fork of Blue creek by Teets:

Section 2.9 Miles East of Blue Creek, Elk District.

		Thickness Feet.	Total Feet.	
Conemaugh Series (405')				
Sandstone		30	30	
Sandy shale and concealed		30	60	
Red shale, dark		10	70	
Sandy shale and concealed		20	90	
Red shale		20	110	
Sandy shale and concealed		25	135	
Sandstone, massive, Grafton		45	180	
Sandy shale and concealed		30	210	
Red and sandy shale, Saltsburg		60	270	
Sandstone, massive, medium coarse ....45 Sandy shale 15	Buffalo	60	330	
Sandstone, massive....25 Sandy shale ....10 Sandstone, massive....40	Mahoning	75	405	405'
Allegheny Series (175')				
Fire clay, Upper Freeport coal horizon		2	407	
Sandstone		18	425	
Fire clay		2	427	
Sandstone, massive		23	450	
Sandy shale		10	460	
Sandstone, massive, East Lynn		115	575	
Coal blossom, No. 5 Block		5	580	175'

The above section gives the thickness of the Allegheny as 175 feet.

The following section was measured by Teets from a point southeast of Spangler P. O., at the head of Laurel Fork, in the Cabin Creek-Elk district line, northwest along county road to head of Spangler Fork:

Section 1 Mile Southeast of Spangler P. O., Elk District.

		Thickness Feet.	Total Feet.	
Conemaugh Series (210')				
Concealed		100	100	
Sandstone, massive, coarse, Buffalo		25	125	
Sandstone and concealed		15	140	
Sandstone, massive, micaceous, friable, Mahoning		70	210	210'
Allegheny Series (165')				
Sandy shale and concealed		120	330	
Sandstone, massive, East Lynn		40.5	370.5	
Coal 0'-11" Coal, bone 0'- 3" Coal 0'- 6" Coal, bone 0'- 2" Coal, block 2'- 8"	No. 5 Block	4.5	375	165'
Upper Kanawha Series (215')				
Sandstone and concealed, Homewood		150	525	
Sandstone, massive		15	540	
Kanawha Black Flint		6	546	
Sandstone and concealed		24	570	
Shale roof— Slate, black 0'- 4" Coal, soft 0'- 6" Slate, gray 0'- 2" Coal, medium hard 0'- 7" Slate, gray 0'- 3" Coal 0'- 4" Slate, gray 0'- 2" Coal 0'- 1" Slaty shale 2'-10" Coal 0'- 6" Slate, gray 0'- 2" Coal, block 1'- 7" Slate 0'- 2" Coal, visible 0'- 4.	Stockton-Lewiston	8	578	
Concealed to bed of creek at 1070' A. T. L.		12	590	590'

This is an important section, since it gives the thickness of the Allegheny Series 165 feet, and the interval between the No. 5 Block coal and the Kanawha Black Flint, 165 feet; also the interval between the Kanawha Black Flint and the Stockton-Lewiston coal, 24 feet, near the eastern border of Kanawha county.

The following section was measured from a point north-

east of Apgah P. O., northwest to head of branch of Morris creek:

Apgah P. O. Section, Big Sandy District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (290')			
Sandy shale and concealed	80	80	
Red shale	10	90	
Limestone nodules	2	92	
Red and sandy shale	23	115	
Limestone nodules	2	117	
Red and sandy shale	38	155	
Sandy shale and concealed	35	190	
Fire clay, Bakerstown coal horizon	2	192	
Sandy shale	15	207	
Concealed, Buffalo	53	260	
Sandstone, massive, micaceous, friable	30	290	290'
Allegheny Series (209')			
Fire clay, Upper Freeport coal horizon	3	293	
Sandstone, massive, friable	70	370	
Fire clay	2	372	
Sandy shale and concealed	43	415	
Coal blossom	1	416	
Sandstone and concealed, East Lynn	69	485	
Sandstone roof—			
Coal 1'-6"			
Fire clay shale 7'-4"	11	496	
Coal 2'-2"			
Concealed to 851' A. T. L.	3	499	499'

The following section was measured by Krebs with aneroid, descending from top of a high hill eastward to Middle Fork of Blue creek, 3 miles northeast of Blakely, Elk district:

Section 3 Miles Northeast of Blakely, Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (130')			
Sandy shale, Buffalo	70	70	
Sandstone, massive, coarse grained, Mahoning	60	130	130'
Allegheny Series (230')			
Sandy shale and concealed	10	140	
Sandstone and concealed	50	190	
Sandy shale	5	195	
Sandstone and concealed	95	290	
Sandy shale	5	295	
Sandstone and concealed, East Lynn	60	355	
Coal blossom, No. 5 Block	5	360	230'
Kanawha Series (170')			
Sandstone and concealed, Homewood	165	525	
Kanawha Black Flint	5	530	170'

The foregoing section gives the thickness of the Allegheny Series 230 feet in the southwestern part of Kanawha county.

The following section was measured by Krebs with aneroad, descending eastward from a high knob to Shadrick Fork of Hughes creek, 5 miles north of Cannelton, Cabin Creek district:

Section 5 Miles North of Cannelton, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (100')			
Sandstone and concealed, Mahoning	100	100	100'
Allegheny Series (241')			
Fire clay, Upper Freeport coal horizon...	1	101	
Sandstone, Lower Freeport	59	160	
Fire clay and sandy shale, Lower Freeport	2	162	
Sandstone and concealed	90	252	
Fire clay and slate	3	255	
Sandstone and concealed	32	287	
Coal blossom, Upper Kittanning.....	3	290	
Sandstone, massive, East Lynn.....	45	335	
Coal, block .....0'-10" / Impure coal .....0'-10 / Coal, block .....0'-10" / Slate .....0'- 2" / Coal, splint .....1'-10" — No. 5 Block...	4'-6"	339'6"	
Slate	1'-6"	341	241'
Kanawha Series (145')			
Sandstone and concealed, Homewood....	140	481	
Kanawha Black Flint	5	486	145'

The above section shows the thickness of the Allegheny Series here to be 221 feet, and the interval between No. 5 Block coal and Kanawha Black Flint, 141 ft. 6 in.

The following section was measured by Krebs with aneroad, descending westward into Shirley Branch, along road from Gazil school house:

Gazil Section, Elk District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (290')			
Red shale	20	20	
Sandstone, Grafton	35	55	
Sandy shale and concealed	10	65	
Sandstone and concealed, Saltsburg.....	95	160	
Sandstone, friable, Buffalo-Mahoning.....	130	290	290'

	Thickness Feet.	Total Feet.	
Allegheny Series (150')			
Sandy shale and concealed	60	350	
Sandstone and concealed	85	435	
Coal, No. 5 Block	5	440	150'
Kanawha Series (215')			
Sandy shale and concealed, Homewood	115	555	
Kanawha Flint Ledge	5	560	
Sandy shale	5	565	
Coal blossom, Stockton-Lewiston	5	570	
Sandstone and concealed, Coalburg	80	650	
Coal blossom, Coalburg	5	655	215'

The following section was measured by Krebs with aneroid, descending from a high hill on the Kanawha-Boone county line, into Coal Fork of Cabin Creek, 4 miles west of Leewood, Cabin Creek district:

Section 4 Miles West of Leewood, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Conemaugh Series (38')			
Sandstone and concealed (Mahoning)	38	38	38'
Allegheny Series (202')			
Fire clay, Upper Freeport coal horizon	2	40	
Sandy shale and concealed	28	68	
Fire clay, Lower Freeport coal	2	70	
Sandstone	32	102	
Fire clay	3	105	
Sandstone and concealed	10	115	
Sandstone, pebbly, East Lynn	124	239	
Coal blossom, No. 5 Block	1	240	202'
Kanawha Series (330')			
Sandstone, massive, Homewood	105	345	
Coal blossom, Stockton-Lewiston	5	350	
Sandstone and concealed	35	385	
Coal blossom	5	390	
Sandstone	50	440	
Fire clay, Coalburg coal	5	445	
Sandstone	53	498	
Coal blossom, Winifrede	2	500	
Sandstone and concealed to Coal Fork at 1150' A. T. B.	70	570	330'

The above section shows the thickness of the Allegheny Series to be 202 feet in the southern part of Kanawha county.

DESCRIPTION OF THE ALLEGHENY SERIES.

The Upper Freeport Coal.

The Upper Freeport coal is the top of the Allegheny Series, and was so designated from the town of Freeport, Pennsylvania, by J. P. Lesley, in 1856. Throughout the northern part of West Virginia this is one of the important coal beds, but in the southern part of the State the seam becomes thin and impure, and of little commercial value.

In Kanawha county, the Upper Freeport coal is thin, and often entirely absent. This coal is being opened by Adam Acres on Coal River Branch of the C. & O. R. R., about one mile east of Ballard station, where the following section was measured:

Section at Ballard Station, Washington District.

	Feet.	Inches.
Shale and sandstone	10	0
Impure coal (Upper Freeport)	2	1
Fire clay and shale	5	0
Bastard limestone	2	0
Elevation coal, 655' A. T. B.		

On Trace Fork of Davis creek ¼ mile north of Ruth P. O., Rome Polly once mined the Upper Freeport coal. The opening had fallen shut when visited by Krebs. Polly reported 3 feet of good coal at 750 feet A. T. B.

Further up Trace Fork at Ruth P. O. we find an abandoned opening of the Upper Freeport coal on the farm of Samuel Lively. The people in the village report 3 feet of good coal at 765 feet A. T. B.

On a branch of Alum creek of Coal river, 0.7 mile northeast of Bonami P. O., the following section was measured:

	Feet.	Inches.
Sandstone, massive, Mahoning	30	0
Coal blossom, Upper Freeport, 780' A. T. B.	1	0
Concealed	20	0

The Upper Freeport Limestone.

The Upper Freeport Limestone usually occurs from 1 to 10 feet below the coal and is distributed, somewhat irregularly,

in the northern part of West Virginia, where it is often replaced with fire clay. In Kanawha county this limestone occurs very rarely and is impure.

The Bolivar Fire Clay.

Below the Upper Freeport limestone and often replacing it, wholly or in part, is a bed of fine fire clay in the northern part of West Virginia and western part of Pennsylvania that has been designated the Bolivar Fire Clay, from a town of that name in Westmoreland county, Pennsylvania, where it has long been used for brick making. This clay is thin and unimportant, being only 1 to 3 feet thick in the Kanawha county area, as shown in the sections already given in preceding pages of this volume.

The Upper Freeport Sandstone.

A massive sandstone occurs below the Upper Freeport coal and limestone horizon which has been designated in Pennsylvania the Upper Freeport sandstone.

In Kanawha county this sandstone is often massive and grayish buff, medium coarse, ranging in thickness from 30 to 60 feet, and from 70 to 100 feet above the No. 5 Block coal. It generally forms massive cliffs ranging from 150 to 200 feet in thickness, sometimes including Buffalo, Mahoning, Freeport, East Lynn and Homewood sandstones, all of which have been designated by Campbell the **Charleston sandstone.**

The thickness of this sandstone has been shown in the sections given on preceding pages of this volume.

The Lower Freeport Coal.

At an interval from 30 to 100 feet under the Upper Freeport coal is another bed that has been designated the Lower Freeport coal in Western Pennsylvania. This bed is thin and of little commercial value in Kanawha county; in fact, the coal is nearly always replaced with slate and fire clay. The following section measured from the point of hill just south of South Ruffner, two miles east of Charleston, gives the general occurrence of this seam of coal:

South Ruffner Section, 2 Miles East of Charleston, Loudon District.

	Thickness Feet.	Total Feet.
Sandstone, massive, medium coarse, bluish gray, Upper Freeport	54	54
Coal blossom, Lower Freeport	0-2"	54-2"
Fire clay, bluish buff, Ruffner	6-10"	61
Sandstone and concealed	90	151
Coal blossom, No. 5 Block	2	153
Sandstone, Homewood	50	203
Concealed	29	232
Kanawha Black Flint	6	238
Coal blossom, Stockton-Lewiston	2	240
Sandy shale and concealed	97	337
Coal blossom, Winifrede	3	340
Concealed	38	378
Coal blossom, Chilton	2	380
Sandy shale and concealed to C. & O. R. R. track at South Ruffner, 610' A. T. B.	40	420

The foregoing section shows the **Lower Freeport** coal only two inches thick, underlying the massive sandstone.

The Ruffner Fire Clay.

Under the Lower Freeport coal is a bed of bluish buff fire clay from 5 to 7 feet in thickness which the writer has named the **Ruffner Fire Clay.** This bed has been mined at South Ruffner 2 miles east of Charleston, on the C. & O. Ry., and manufactured into fire brick. It has also been mined on Lick Branch, about one mile east of Charleston, where the following section was measured by the writer:

Lick Branch Section, One Mile East of Charleston, Loudon District.

	Thickness Feet.	Total Feet.
Sandstone, massive, Upper Freeport	60	60
Coal blossom	0-4"	60-4"
Fire clay, Ruffner	5-8"	66
Sandy shale and concealed	24	90
Coal blossom	2	92
Slate	1-6"	93-6"
Sandstone, massive, East Lynn	66-6"	160
Coal blossom, No. 5 Block	2	162
Sandstone, massive, Homewood	60	222
Sandstone and concealed	28	250
Kanawha Black Flint	6	256

The Upper Kittanning Coal.

In some parts of Kanawha county there occurs a fairly persistent coal from 1 to 4 feet thick, under the Lower Freeport sandstone, and from 20 to 60 feet over the No. 5 Block coal that the writer believes is the Upper Kittanning coal, and has so designated it.

The following section was measured by Krebs, with aneroid, descending southward to Cline Branch, 4 miles northeast of Dana, Malden district:

Section 4 Miles Northeast of Dana, Malden District.

	Thickness Feet.	Total Feet.	
Allegheny Series (122'-6")			
Sandstone, massive, Lower Freeport	48	48	
Coal blossom, Upper Kittanning	2	50	
Sandstone and concealed, East Lynn.....	68	118	
Coal .....0'-6" / Slate .....2'-0" / Coal, block .....2'-0" — No. 5 Block..	4-6"	122-6"	122'-6"
Kanawha Series (159'-6")			
Sandstone and concealed, Homewood....	109-6"	232	
Kanawha Black Flint	5	237	
Sandy shale and concealed to 890' A. T. B.	45	282	159'-6"

The above section shows the Upper Kittanning coal 68 feet above the No. 5 Block coal and 182 feet above the Kanawha Black Flint.

Another section measured on north side of Elk river, ½ mile north of Milliken station, in Elk district, gives the following:

Milliken Station Section, Elk District.

	Thickness Feet.	Total Feet.
Sandstone, massive, Lower Freeport.		
Coal blossom, Upper Kittanning	2	2
Sandstone	8	10
Coal blossom, No. 5 Block, Lower Kittanning.....	2	12
Sandstone, massive	16	28
Fire clay	2	30
Sandstone, Homewood	30	60

The interval between the Upper and Lower Kittanning coals appears to be only 8 feet at this point.

Another section measured at Republic, in the southern part of Kanawha county, in Cabin Creek district, shows the following:

Republic Section, Cabin Creek District.

		Thickness Feet.	Total Feet.
Sandstone, massive, Lower Freeport;;		56	56
Coal .....0'-4"			
Slate .....0'-4"	Upper Kittanning	3'-8"	59'-8"
Coal .....3'-0"			
Sandstone, shelly, East Lynn		71'-4"	131'-0"
Slate		0'-6"	131'-6"
Coal .....0'-4"			
Slate .....0'-4"			
Coal .....3'-0"	No. 5 Block, Middle and		
Fire clay .....0'-1½"	Lower Kittanning).....	7'-9½"	139'-3½"
Coal, hard ....4'-0"			

The following section was measured on Shadrick Fork of Hughes creek, 5 miles north of Cannelton, Cabin Creek district:

Section on Shadrick Fork, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandstone and concealed	32	32
Coal blossom, Upper Kittanning	3	35
Sandstone, massive, East Lynn	45	80
Coal blossom, No. 5 Block	5	85
Sandstone and concealed, Homewood	140	225
Kanawha Black Flint	...	...

The East Lynn Sandstone.

Underlying the Upper Kittanning coal is a massive grayish buff, pebbly sandstone, 30 to 100 feet thick, that has been designated the **East Lynn Sandstone,** from a village of that name in Wayne county. This is a very persistent sandstone throughout the southern part of West Virginia, and usually forms bold cliffs along its outcrop. It rises out of Kanawha river between Spring Hill and South Charleston, and gradually rises above the same except in the synclinal flexures until at Montgomery, 26 miles east of Charleston, it caps the hills at an elevation of 1555 feet A. T. B., or 915 feet above the level of the railroad, with a thickness of 40 to 60 feet.

The East Lynn sandstone rises out of Coal river, between the forks of Coal and Sproul, where is appears in the railroad cut, 40 to 50 feet thick, bluish gray, and micaceous, the top portion being conglomeratic.

This sandstone comes out of Davis creek, between Spring Hill and mouth of Dry Branch of Davis creek, and gradually rising above the floor of the valley, forms massive cliffs 60 to 70 feet high to the head of Davis creek at the divide between Davis, Lens and Lick creeks on the Warfield anticline, where this sandstone caps the highest hills at an elevation of 1445 feet A. T. B.

The East Lynn sandstone caps the high hills on the head of Tenmile Fork of Cabin creek, between Cabin creek and Seng creek, where it forms cliffs 60 to 70 feet high at an elevation of 1725 feet A. T. B.

This sandstone goes under Elk river between Bream and Pinchton, and comes out of the river again between Reamer and Clendenin, rising rapidly above the floor of the valley until of Queen Shoals it is 200 feet above the level of the Coal & Coke Railway at an elevation of 840 feet and 60 feet thick.

The East Lynn sandstone comes out of Blue creek about one mile east of its mouth, and rising rapidly above the valley it reaches at Blakely an elevation of 1330 feet A. T. L., or about 220 feet above the floor of the valley.

The East Lynn sandstone forms a good building stone and has been quarried in different parts of the county for house foundations, bridge piers and other building material. Its quality as a building stone will be further discussed in a succeeding chapter. This sandstone appears to occupy the same geological horizon as the Lower Freeport sandstone of the Allegheny river region, and is most probably identical with it.

The No. 5 Block (Middle Kittanning) Coal.

At 1 to 10 feet under the East Lynn sandstone there occurs the most persistent coal bed in the whole Allegheny series. This bed has been mined in the Kanawha Valley for more than 75 years, and was named **the No. 5 Block Coal.** It lies from 60 to 200 feet above a hard, persistent black flint rock, which occurs in the Kanawha and Elk valleys and has been

named the **Kanawha Black Flint.** This bed of coal is nearly always found at its proper geological horizon and of workable thickness, and most probably represents the Lower and Middle Kittanning beds combined, since the bed is generally a multiple one, separated into two or more strata by partings of slate and bone.

In Kanawha county this coal is usually of "Block" type, and is hard, breaking into large blocks. It forms an excellent steam and domestic fuel, is very hard, not breaking easily in marketing, and does not disintegrate when exposed to the air, thus forming an excellent coal for shipping purposes.

This coal comes to the level of the C. & O. Railway grade at the mouth of Elk river, where it is 2 feet thick and rising rapidly to the southeast, until at Crescent, at the eastern limit of Montgomery, it is more than 900 feet above the C. & O. Railway grade. It appears above Davis creek at the mouth of Dry branch, where it is mined for local fuel use. It goes under Elk river at Bream and Pinchton, and remains under until between Reamer and Clendenin, where it comes above the grade of the Coal & Coke Railroad, and has been mined just east of Clendenin. At Queen Shoals, 3 miles northeast of Clendenin, this coal is mined 200 feet above the level of the railroad.

The No. 5 Block coal was once mined on Big Creek river, between the forks of Coal and Sproul, about one-half mile north of the latter place, and shipped down the river in boats. The mines are now abandoned and fallen in, but the coal was reported to be three and one-half to four feet thick, with a slate parting.

The general section of the No. 5 Block coal, as measured at the O'Knight and Meyer opening on Page Branch of Davis creek, exhibits the following structure:

Section of O'Knight and Meyer Coal Opening, Loudon District.

		Thickness Feet.
Gray shale, fossil plants		1'-0"
Draw slate		0'-1"
Coal, hard ..... 0'-11"		
Slate, dark gray ..... 0'- 1"		
Coal, soft ..... 0'- 9"	No. 5 Block	3'-3"
Slate, hard, dark ..... 1"		
Coal, block ..... 1'- 5"		

Slate floor. Elev. 795' A. T. B.

The following section, taken at the mine of the Eureka Colliery Co., at Donwood, on Morris creek, where the No. 5 Block coal has been mined for more than 30 years, gives the general structure of this coal:

Section of Eureka Colliery Company Mine.

		Feet.	Inches.
Sandstone, massive		...	...
Slate .....1 to 2'-0"			
Coal, impure.....0'-4"			
Coal, splint .....0'-5"			
Bone .....0'-1"			
Coal, gray, hard....1'-0"			
Coal, semi-splint ....0'-9"	No. 5 Block..	7	0
Coal, gas .....0'-4"			
Coal, splint .....2'-5"			
Slate .....1'-4"			
Coal, gas (reported).0'-4"			
Sandstone, massive, Homewood		65	...
Kanawha Black Flint		6	...

Another section measured in the Turner mine, on Morris creek, one mile southeast of Turner, operated by the Morris Fork Coal Company, shows the structure of the No. 5 Block coal as follows:

Section of Turner Mine, Elk District.

		Feet.	Inches.
Sandstone, massive.			
Slate .....2 to		5	0
Coal, splint .....1'-6"			
Slate .....0'-4"	No. 5 Block..	4	1
Coal, block, hard...2'-3"			
Slate floor. Elev. 745' A. T. B.			

The following section was taken in the mine of Sidney Nelson, on Elk river, one mile west of Bream station, where the No. 5 coal is mined, and shows the general structure of the coal at that point:

Section of Sidney Nelson Coal Opening, Elk District.

		Feet.	Inches.
Sandstone.			
Coal, hard, block ..2'-11"			
Slate ..... 6"			
Coal ..... 7"	.....	5	0
Slate ..... 4"			
Coal .....1'- 6"			
Sandstone floor, 650' A. T. B.			

In the head of Campbell Fork of Bell creek, 1.2 miles northeast from Blakely P. O., just south of the Cabin Creek-Elk district line, above the county road, L. S. Hill is mining the No. 5 Block coal, where the following section was measured by Teets:

Section of L. S. Hill Mine, Cabin Creek District.

		Feet.	Inches.
Sandstone, massive.			
Slate, dark.			
Coal .....0′-9″			
Bone .....0′-4″			
Coal, good .....1′-1″	.....	5	0
Bone .....0′-1″			
Coal, gas .....0′-6″			
Coal, block .....2′-3″			

The No. 5 Block coal is sometimes replaced with a cannel bed, like that now on Mill creek and Falling Rock creek of Elk river. On Falling Rock creek it was mined and manufactured into oil and other products before the late civil war. The oil factory was located a mile and a half up Falling Rock creek, where the cannel coal occurs from 2 to 3 feet thick.

Other sections showing the thickness of the No. 5 Block coal will be given in a succeeding chapter of this volume.

Clarion Coal.

At 10 to 30 feet underneath the No. 5 Block coal there often appears a thin bed of coal in some parts of Kanawha county that may correlate with the Lower Kittanning bed, or may very probably represent the Clarion bed, found in the northern part of West Virginia. This coal appears at Bream, on Elk river, where it occurs 14 feet under the No. 5 Block, and is separated from it by shale and sandstone, as exhibited in the following section:

Bream Section, Elk District.

		Thickness Feet.	Total Feet.
Coal, No. 5 Block—			
Shale and sandstone		14	0
Coal .....1′-6″			
Dark shale ..... 6″	Lower Kittanning or Clarion	3	6
Coal .....1′-6″			
Elevation 640′ A. T. B.			

Another section opened by Mr. C. C. Lewis, Sr., of Charleston, near Mammoth, on Fivemile Branch of Kelly creek, about two miles above its mouth, published in Vol. II (A), page 544, West Virginia Geological Survey, exhibits the following:

Mammoth Section, Cabin Creek District.

		Feet.	Inches.
Coal, No. 5 Block—			
Interval		20	0
Coal .....2'-0"	Lower Kittanning or Clarion	4	6
Slate .....1'-0"			
Coal .....1'-6"			
Interval		125	0

This coal has not been opened in many places in Kanawha county, and is possibly often absent and of very little commercial value, since it does not appear to have been mined at any point, unless the lower seam at Mason could represent this coal.

CHAPTER IX.

THE POTTSVILLE SERIES.

The Pottsville Series, as agreed upon by geologists and paleobotanists, ends at the top with the Homewood sandstone and extends down through a series of rocks to the Mauch Chunk Shales, a depth of only 200-300 feet in the northern edge of the State, but to nearly 2500 feet in the southern portion.

Dr. I. C, White gives the following description of the Pottsville series in Volume II, pages 611-612, West Virginia Geological Survey, 1903:

"The Pottsville series being composed mainly of very hard and often pebbly sandstones the grains of which are cemented with silica and peroxide of iron, become almost indestructible by ordinary atmospheric agencies, and it has thus proved a most important factor in shaping the topography around the margins of the Carboniferous system. Wherever these beds come to the surface in West Virginia, wild scenery and rugged topography are sure to be found. Rapid streams, high waterfalls, 'rock cities,' great cliffs, precipitous slopes and barren regions generally mark the lines where these rocks emerge to daylight. The lofty peaks of the Allegheny Mountains owe their origin to this friendly mantle, while its upturned edges have preserved many coal basins from complete erosion.

"The deep gorges, narrow canyons and wild scenery of the Cheat, North Potomac, Tygarts Valley, Little and Big Kanawhas, Guyandot and Tug rivers are all carved from these rocks. The 'Falls' of both Kanawhas, the Black Water and Stony rivers are over these rocks, as well as the 'Roughs' of Tug and Guyandot. A belt of evergreen vegetation, laurel, hemlock, pines, etc., marks the soil (usually too poor, stony and infertile for agriculture) derived from this series.

"It was formerly supposed that this hard white sandstone series at the base of the Coal Measures held no coal beds of commercial value, but the investigations of recent years have revealed the fact that some of the purest and most valuable coals of the entire Appalachian field are bound up between the great cliffs of the Pottsville series, along its southeastern crop across the State so that on the Kanawha, New and Tug rivers this series now furnishes some of the purest coal and cokes of the State. One of the peculiarities of the Middle and Lower Pottsville coals in which they resemble the Allegheny-Kanawha series above, is their distribution in a comparatively narrow

belt, only twenty-five to thirty miles wide around the southeastern border of the Appalachian field, since in passing northwestward these early coals thin away and disappear in a mass of pebbly sandstones and sandy beds in which no coal of commercial value is found. This same state of affairs is true along the northwestern crop of the Pottsville series across western Pennsylvania and southeastern Ohio, and hence there is no reason for believing that West Virginia has any Pottsville coals of much commercial value outside of the counties of McDowell, Wyoming, Mercer, Raleigh, Summers, Fayette, Nicholas, Greenbrier, Webster, Randolph, Tucker, Grant and eastern Preston. True, the Pottsville rock series underlies all the region of the State west from the counties named, but it consists largely of coarse sandstone and conglomerates in which the drill of the gas and oil seeker reports no coal of commercial value except an occasional sporadic seam which may hold more slate than coal."

The Pottsville series of West Virginia has been further divided by Dr. I. C. White into three great groups, named respectively Upper or Kanawha, Middle and Lower Pottsville, as shown in the following scheme of classification:

POTTSVILLE SERIES.	Upper	Beaver Group.	Homewood sandstone stage. Mercer stage. Connoquenessing sandstone stage.
	Middle	New River Group.	Nuttall sandstone. Sewell coal. Raleigh sandstone. Beckley coal. Quinnimont sandstone and shales. Fire Creek coal.
	Lower	Pocahontas Group.	Flat Top Mt. sandstone. Pocahontas coals, No. 6, 5, 4, 3, 2, and 1 with intervening sandstone and shales. Pocahontas sandstones.

In this classification the name of each group is given from the region where the rocks of the same were first studied and classified. The Upper Pottsville sediments were first studied and its principal members described in detail along the Beaver river of Lawrence and Beaver counties, Pennsylvania, by Dr. White, 1876, and from these studies Prof. Lesley named the rocks involved the **Beaver Group.**

The Upper Pottsville or Kanawha series extends from the top of the **Homewood sandstone** to the top of the **Nuttall sandstone,** having a thickness of over 1600 feet in the southern part of Kanawha county and being divided into two well marked groups, the **Upper** and **Lower.**

Dr. I. C. White gives the following description of these beds in Volume II (A), page 270, West Virginia Geological Survey, 1908:

The Upper Kanawha Beds.

"The dull, dove colored, micaceous, flaggy and massive sandstones with calcareo-silicious layers end suddenly and are frequently overlaid with slight unconformity by an entirely different type of sediments, a massive grayish white sandstone, coarser in grain, and containing very little mica. Fragments of the sandstones which overlie the **Lower Kanawha** beds are readily distinguishable from those of the latter, being frequently conglomeratic, especially the higher members, and much resembling the **Pottsville** of western Pennsylvania, except that the rocks are seldom so hard and silicious as either the **Connoquenessing** or **Homewood** sandstones of the region in question.

"But great as is the difference in the character of the mechanical sediments between the **Upper** and **Lower Kanawha** beds, it is even greater in the character of the included coals. As already stated, the coals of the **Lower Kanawha** are of the softer type, and thus are transitional in physical structure from the soft, columnar, and prismatic coals of the **New River** of **Pocahontas type** to the hard, splint and 'block' coals of the **Upper Kanawha beds,** as exhibited by the **Winifrede, Coalburg,** and **Lewiston** or **Stockton types.** The coals of the **Lower Kanawha** are suitable for coking, gas making and the general purposes of fuel, while those of the **Upper Kanawha** are not naturally coking coals (although they would coke all right if crushed), but they come out in such large and solid blocks, and stand the handling of transportation so well that they make ideal coals for steam and domestic use, so that the name **Kanawha Splint** is synonymous in the coal trade with a general fuel of great excellence."

General Section of Kanawha Series.

Upper Kanawha Series (207 to 479)	Feet.	to	Feet.
Homewood sandstone	50	to	100
Sandy shale, often holding coal beds	0	to	30
Kanawha Black Flint	0	to	10
Shales	5	to	30
Coal, Stockton-Lewiston-Belmont, always multiple and in 2 to 4 divisions separated by shale	4	to	12
Coalburg Sandstone, coarse, massive, gray, often weathering into "Chimney rock" columns on the summit	50	to	80
Shale	5	to	10
Coalburg Coal, multiple bedded	4	to	10

Sandy shale or impure fire clay	10	to	20
Upper Winifrede sandstone, massive, yellowish gray coarse in upper half, but close and fine below	50	to	110
Winifrede coal, multiple	4	to	12
Sandy shale and impure fire clay	5	to	15
Lower Winifrede sandstone, grayish white, often massive	20	to	40
Lower Kanawha Series—			
Chilton sandstone, dull gray or dovecolored, fine grained, micaceous, often containing calcareous silicious layers	30	to	50
Chilton Coal, usually impure, double separated by layers of fire clay, seldom of commercial value	2	to	6
Fire clay	3	to	5
Sandstone and shale, often containing a silicious limestone with marine fossils	20	to	40
Coal, Thacker, Block Seam	2	to	4
Cedar Grove sandstone, dull gray or dove-colored, micaceous, but often flaggy, making steep bluffs in the topography	100	to	200
Cedar Grove Coal, hard, blocky	2	to	6
Fire clay and shale	5	to	10
Sandstone or sandy shale, holding a silicious limestone, Campbell's Creek, in lower half	80	to	150
Campbell's Creek Limestone	1	to	2
Peerless Coal, upper division of Campbell's Creek, softer than Cedar Grove, excellent gas coal	2	to	4
Fire clay and shale	2	to	10
Sandstone and sandy shale	5	to	20
No. 2 Gas Coal, Island Creek seam of Guyan river, Warfield and Rawl bed of Tug River, Ansted seam in Fayette county, Coal Valley Gas seam at Montgomery, the most persistent and valuable bed in the Kanawha series	2	to	10
Fire clay and shales	2	to	10
Brownstown sandstone	35	to	60
Powellton Coal	1	to	6
Shales and sandstone, often holding a silicious limestone	60	to	100
Stockton-Cannelton Limestone, near center	1	to	2
Eagle Coal, No. 1 Gas, multiple bedded, soft good for coke or gas, columnar in structure, and approaching New River type or Middle and Lower Pottsville coal in physical aspect	2	to	12
Decota sandstone and shales	20	to	60
Little Eagle Coal, soft	1	to	4
Shale and sandstone	40	to	50
Black slate	2	to	10
Limestone, Eagle, Black marble.			
Slate	1	to	2
Dark shale	5	to	10
Shales and sandstone	100	to	200
Upper War Eagle coal	2	to	5
Shales and sandstone	100	to	220
Coal, Middle War Eagle	2	to	6

Shale and sandstone	100 to 250
Coal, Lower War Eagle	2 to 4
Shales and sandstone to base of Kanawha series and top of the great Nuttall sandstone	40 to 50
Totals	972 to 2034

In addition to the sections already published, several other sections will now be given showing the Kanawha measures.

The following section was measured by Teets, descending from a high point one mile north of Dry Branch, south of C. & O. Railroad track .03 mile northwest of Dry Branch:

Section 0.3 Mile Northwest of Dry Branch, Cabin Creek District.

Kanawha Series (675')	Thickness Feet.	Total Feet.	
Sandstone, massive, Homewood	75	75	
Kanawha Black Flint	6	81	
Sandstone and concealed	29	110	
Coal (abandoned opening fallen in), Stockton-Lewiston	4	114	
Sandstone and concealed, Coalburg	61	175	
Coal, Coalburg (abandoned opening fallen in)	5	180	
Concealed and sandstone	125	305	
Concealed	15	320	
Sandstone and concealed	175	495	
Concealed	130	625	
Coal, No. 2 Gas (abandoned opening fallen in)	3	628	
Sandstone and sandy shale	42	670	
Coal, Powellton	2	672	
Sandy shale to C. & O. railroad track. Elevation 650' A. T. B.	3	675	675'

The above section shows the interval between the No. 2 Gas and Kanawha Black Flint to be 547 feet, and the Stockton-Lewiston coal is 29 feet under the flint. The Coalburg coal comes 61 feet under the Stockton and 94 feet under the Kanawha Black Flint. The Coalburg and No. 2 Gas coals are being mined here.

The following section was measured by Teets, descending from a high point just northwest of the mouth of Slaughter creek at Chelyan station, southwestward to the C. & O. R. R. track:

Section 0.2 Mile Northwest of Chelyan, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandstone, massive, East Lynn	80	80
Sandy shale	10	90
Sandstone, massive, Homewood	86	176
Kanawha Black Flint	4	180
Sandy shale and concealed	8	188
Coal blossom, Stockton-Lewiston	2	190
Sandstone, massive, Coalburg	70	260
Coal blossom, Coalburg	1	261
Sandstone and concealed	129	390
Sandstone, massive	30	420
Sandy shale	20	440
Sandstone, massive	60	500
Concealed	247	747
Coal blossom, No. 2 Gas	3	750
Concealed to C. & O. R. R. track. Elev. 625' A. T. B.	25	775

The above section shows the interval between the Kanawha Black Flint and No. 2 Gas coal, 567 feet, and the interval between the Stockton-Lewiston and Coalburg coals 70 feet.

The following section was measured with aneroid by Teets, descending northward from a high point, ¾ mile south of Crown Hill, along a trail to Crown Hill station:

Crown Hill Section, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny-Kanawha Series (970')			
Sandstone and concealed	296	296	
Kanawha Black Flint	5	301	
Sandstone, massive	25	326	
Coal, splint ....0'-4" / Slate and nigger head....0'-3" / **Coal** ....3'-5" — Stockton-Lewiston .. (Belmont)	4	330	
Fire clay floor.			
Sandstone and concealed	95	425	
Slate, draw	1	426	
Coal, Coalburg: **Coal** ....0'-9" / Bone ....0'-7" / **Coal**, block ...2'-2" / Bony slate ....0'-3" / **Coal**, gas ....1'-3"	5	431	
Sandstone and concealed	50	481	
Coal blossom, Winifrede	4	485	
Sandstone and concealed	345	830	
Coal blossom. Peerless	2	832	
Concealed to level of C. & O. Ry. Elev. 630' A. T.	138	970	970

The above section shows the interval between Kanawha Black Flint and the Peerless coal to be 529 feet, and the interval between the Stockton-Lewiston and Coalburg coal 95 feet.

The following section was measured by Teets, descending from a high point ¼ mile west of Lewiston, eastward down hill to the C. & O. Railroad level at Lewiston:

Lewiston Section, Cabin Creek District.

	Thickness Feet.	Total Feet.
Kanawha Series (740')		
Concealed	75	75
Sandstone, massive, coarse, Homewood	65	140
Kanawha Black Flint	5	145
Sandstone and concealed	15	160
Coal (abandoned opening, reported 5 feet), **Stockton-Lewiston**	5	165
Concealed	135	300
Coal, (abandoned opening) **Winifrede**	3'-6"	303'-6"
Sandstone and concealed	31'-6"	335
Coal (abandoned opening), **Chilton** reported	3	338
Concealed	92	430
Sandstone	30	460
Concealed	16	476
Coal, abandoned opening, **Thacker ?** reported	4	480
Sandstone, massive	50	430
Concealed	50	580
Sandstone, massive, fine grained	20	600
Concealed	20	620
Coal blossom, Cedar Grove	2	622
Sandstone and concealed	18	640
Sandstone, massive	35	675
Concealed	25	700
Coal, Peerless	3	703
Concealed	25	728
Coal blossom, No. 2 Gas	3	731
Concealed to Kanawha river	50	781

The interval between the Kanawha Black Flint and Peerless in the above section is 555 feet.

The following section was measured by Teets, descending from a high point just south of Coalburg, northward down mule path to Coalburg:

Coalburg Section, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (105')			
Sandstone and concealed, East Lynn	100	100	
Coal blossom (old opening fallen shut) No. 5 Block	5	105	105'
Kanawha Series (775')			
Sandstone, massive, medium coarse	85	190	
Coal blossom	1	191	
Sandstone and concealed, Homewood.....	84	275	
Coal blossom, Stockton-Lewiston	2	277	
Sandstone and concealed	118	395	
Slate	0'-8"	395'-8"	
Coal, Coalburg { **Coal** .....1'-0" / Bone .....0'-2" / **Coal** .....3'-2" }	4'-4"	400	
Sandstone, sandy shale and concealed....	160	560	
Concealed	40	600	
Sandstone, massive	60	660	
Sandstone and concealed	75	735	
Coal, old opening fallen shut, **Cedar Grove**	3	738	
Concealed to C. & O. R. R. track at Coalburg. Elev. 625' A. T. B.....	122	860	755'

The above section shows the interval between the Stockton-Lewiston coal and Cedar Grove to be 458 feet.

The following section was measured with aneroid by Teets, descending from a high point just northeast of Ronda, southwest down hill to Ronda:

Ronda Section, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (150')			
Sandstone and concealed	150	150	150'
Kanawha Series (753')			
Sandstone, Homewood	100	250	
Concealed	20	270	
Sandstone and concealed	50	320	
Sandstone	10	330	
Kanawha Black Flint	3	333	
Sandstone, massive	27	360	
Coal, Stockton-Lewiston	5	365	
Sandstone and concealed	75	440	
Coal, Coalburg, good	4	444	
Sandstone, massive, Winifrede	111	555	
Concealed, Winifrede coal horizon	15	570	
Sandstone	75	645	
Sandy shale and concealed	90	735	
Sandstone, massive	79	814	
Coal, Cedar Grove	1	815	
Concealed	60	875	
Coal, Peerless, good	3	878	
Concealed to 662' A. T. L.....	25	903	753'

The above section shows the interval between the Kanawha Black Flint and the Peerless coal to be 542 feet, and the interval between the Stockton-Lewiston and Coalburg coals 75 feet. The massive sandstone underneath the Coalburg coal is undoubtedly the Winifrede sandstone. The Coalburg coal is being mined by the Coalburg Colliery Company at this place.

The following section was measured by Krebs, with aneroid, descending southward at Horton Mine No. 1 on Paint Branch, 1 mile southeast of Sharon P O.:

Section 1 Mile Southeast of Sharon P. O., Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny-Kanawha Series (581')			
Sandstone and concealed	160	160	
Sandstone, massive, Homewood	70	230	
Sandy shale	20	250	
Coal blossom, Stockton-Lewiston	1	251	
Sandstone and concealed	69	320	
Coalburg Coal. Coal, impure 2'-6"; Coal, concealed 0'-4"; Coal, block 2'-2"; Bone, nigger head 1'-0"; Coal, block 1'-6"; Coal, gas 1'-6"	9	329	
Sandstone and concealed	60	389	
Coal blossom	1	390	
Sandstone and concealed	64	454	
Coal blossom, Winifrede	2	456	
Sandstone and concealed	100	556	
Coal blossom, Thacker	2	558	
Sandstone and concealed	20	578	
Coal blossom	3	581	581'

The following section was measured by Krebs, descending northwestward from a high summit between Laurel Fork of Coal Fork of Cabin creek and Main Cabin creek one mile west of Eskdale and joined onto Core Drill Hole No. 1 (699) on lands of LaFolette et al. on Laurel Fork.

Section 1 Mile West of Eskdale, Cabin Creek District.

	Thickness Feet.	Total Feet.
Kanawha Series (790')		
Sandstone and concealed, Homewood	100	100
Coal blossom, Stockton-Lewiston	3	103
Sandstone and concealed, Coalburg	130	233
Coal blossom, Coalburg	2	235
Sandstone (Winifrede) and concealed	105	340

	Thickness Feet.	Total Feet.	
Coal blossom, Winifrede	3	343	
Sandstone and concealed	200	543	
Coal, Cedar Grove	2'-9"	545'-9"	
Sandstone and concealed to top of core drill hole No. 1 (699')	82'-3"	628	
Surface	18	646	
Sandstone	5	651	
Dark clay	0'-6"	651'-6"	
Sandstone	7'-6"	659	
Dark shale	3	662	
Sandy shale	31	693	
Coal, Peerless	1'-5"	694'-5"	
Dark shale	10'-7"	705	
Sandstone	9	714	
Coal, No. 2 Gas. Coal, good .... 1'-6" / Light shale ...18'-6" / Coal, good .... 2'-8"	22'-8"	736'-8"	
Fire clay	6	742'-8"	
Sandstone, Brownstown	30	772'-8"	
Dark slate	0'-4"	773	
Coal, Powellton	2'-6"	775'-6"	
Fire clay	9'-6"	785	
Sandstone	5	790	790'

The above section gives the interval between the Stockton-Lewiston and the Peerless coal 591'-5", and that of the No. 2 Gas, 611 feet. The Coalburg coal comes 130 feet below the Stockton-Lewiston and the Winifrede 105 feet below the Coalburg coal.

The following section was measured by Teets with aneroid, descending from a high point east of Ohley, westward to Ohley:

Ohley Section, Cabin Creek District.

	Thickness Feet.	Total Feet.
Allegheny-Kanawha Series (855')		
Sandstone and concealed	292	292
Silicious shale, flinty, fossiliferous, Kanawha Black Flint	3	295
Shale	10	305
Coal, good Stockton-Lewiston	5	310
Sandy shale	55	365
Slaty shale	2	367
Sandy shale and concealed	33	400
Coal blossom, Coalburg	2	402
Sandstone, massive, medium coarse grained	25	427
Coal blossom	2	429
Sandstone and sandy shale	86	515

	Thickness Feet.	Total Feet.	
Coal blossom, Winifrede	1	516	
Sandstone, massive	25	541	
Concealed	8	549	
Coal blossom, Chilton	1	550	
Sandstone, massive	54	604	
Coal blossom, Thacker	1	605	
Sandstone, massive	74	679	
Coal blossom	1	680	
Sandy shale and concealed	48	728	
Coal blossom, Cedar Grove	2	730	
Sandy shale and concealed	85	815	
Sandstone, massive	38	853	
Coal, Peerless. 785' A. T. B.	2	855	855'

The above section gives the interval between the Stockton-Lewiston coal and Coalburg 90 feet, and the interval between the Coalburg and Winfrede coals 113 feet, while that from the Black Flint to the Peerless, 560 feet.

The Stockton-Lewiston coal is mined by the Cabin Creek Consolidated Coal & Coke Company at Ohley.

The following section was measured by Krebs, descending from a high summit northward to Cane Fork of Cabin creek, 0.5 mile east of Eskdale:

Section 0.5 Mile East of Eskdale, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (215')			
Sandstone and concealed (Bench)	90	90	
Sandstone and concealed (Bench)	44	134	
Sandstone with iron nodules	80	214	
Coal blossom, No. 5 Block	1	215	215'
Kanawha Series (722')			
Sandstone, Homewood, massive	95	310	
Silicious shale and slate. Kanawha Black Flint horizon	2	312	
Stockton-Lewiston { Coal, hard 2' / Slate 2' / Coal 6' }	10	322	
Sandy shale and sandstone	40	362	
Sandstone and concealed	52	414	
Dark, bituminous slate	4'-4"	418'-4"	
Coal, Coalburg	3'-8"	422	
Sandstone	76	498	
Coal blossom, Winifrede	2	500	
Sandstone and concealed	68	568	
Coal blossom, Chilton	2	570	
Sandstone, massive	35	605	

Sandstone and concealed	127	732	
Coal blossom, Cedar Grove	2	734	
Sandstone	100	834	
Coal blossom, Peerless	1	835	
Sandy shale and sandstone	87	922	
Coal, No. 2 Gas	5	927	
Sandstone and concealed to 865' A. T. B...	10	937	722'

The above section gives the interval between three seams of coal opened and mined by the National Bituminous Coal & Coke Company (formerly Holly & Stephenson Coal & Coke Company). The three seams are the following: The Stockton-Lewiston 600 feet, above the No. 2 Gas, and the Coalburg 500 feet above the No. 2 Gas. The No. 2 Gas is worked at tipple height. The interval between the Coalburg and Stockton-Lewiston coal is 96'-4", and the Winifrede coal is 76 feet under the Coalburg.

The following section was measured by Krebs, descending westward from a high summit of a hill at Sand City, Cabin Creek district.

Sand City Section, Cabin Creek District.

Kanawha Series (631')	Thickness Feet.	Total Feet.	
Sandstone and concealed	100	100	
Coal blossom, Stockton-Lewiston	3	103	
Sandstone and concealed, Coalburg	97	200	
Coal, Coalburg	5	205	
Sandstone, massive, Winifrede	78	283	
Coal blossom, Winifrede	2	285	
Sandstone and concealed	65	350	
Coal blossom, Chilton	1	351	
Sandstone and concealed	52	403	
Impure limestone, fossiliferous	1	404	
Coal blossom, Thacker	2	406	
Sandstone, massive	84	490	
Coal blossom, Cedar Grove	1	491	
Sandstone and concealed	79	570	
Coal blossom, Peerless	1	571	
Sandstone and concealed	55	626	
Coal, No. 2 Gas	2'-6"	628'-6"	
Slate to level of siding. Elev. 745' A. T. B.	2'-6"	631	631'

The interval between the Coalburg coal and the top bench of the **No. 2 Gas** in the above section is 421 feet, and that of the Lewiston and No. 2 Gas is 523 feet compared with 600 feet at Eskdale, and 613 feet in the Laurel Fork section.

The following section was measured by Teets from a high point, just south of Lamont, descending northward down the mule path to Lamont:

Lamont Section, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (121')			
Sandstone, massive and concealed	120	120	
Coal blossom, No. 5 Block.....	1	121	121'
Kanawha Series (758')			
Sandstone, massive and concealed, Homewood	115	236	
Coal, Stockton-Lewiston	4	240	
Sandy shale and concealed	70	310	
Coal blossom	1	311	
Sandy shale and concealed	24	335	
Coal, Coalburg	4	339	
Sandstone and concealed	91	430	
Coal blossom, Winifrede	2	432	
Sandstone and concealed	78	510	
Sandy shale	68	578	
Coal blossom, Thacker	2	580	
Sandstone	45	625	
Sandy shale and concealed	72	697	
Coal blossom, Cedar Grove	3	700	
Sandstone and concealed	123	823	
Coal blossom, Peerless	2	825	
Sandy shale and concealed	50	875	
Coal, No. 2 Gas, to 1020' A. T. B......	4	879	758'

The No. 2 Gas, the Stockton-Lewiston and the Coalburg coals have been mined by the Lamont Mining Company where this section was taken. The interval between the No. 2 Gas coal and the Stockton-Lewiston is 635 feet, and of the Winifrede above the No. 2 Gas is 443 feet.

The measures rise rapidly southeastward up Cabin creek, since the No. 2 Gas seam, mined at tipple height, or 40 feet above the bed of Cabin creek, at Eskdale, is 168 feet above the creek at ¾ mile southeast of Acme, as shown in the following section measured by Teets with aneroid descending westward from a high point one mile southwest of Acme, to Tenmile of Cabin creek, ¾ mile south of Acme:

Section ¾ Mile Southeast from Acme, Cabin Creek District.

Kanawha Series (970')	Thickness Feet.	Total Feet.	
Concealed	40	40	
Sandstone, massive	50	90	
Coal blossom, Stockton-Lewiston	2	92	
Sandstone, massive, cliff rock	43	135	
Concealed	10	145	
Sandstone, massive, cliff rock	85	230	
Concealed	8	238	
Coal blossom, Coalburg	2	240	
Sandstone, massive	60	300	
Concealed	40	340	
Winifrede Coal. Coal, splint 4'-6"; Slate 0'-0½"; Coal, splint 0'-1½"	5'-6"	345'-6"	
Concealed	34'-6"	380	
Sandstone, massive	60	440	
Concealed and sandy shale	10	450	
Coal blossom	3	453	
Sandstone, massive cliff rock	97	550	
Sandy shale and concealed	10	560	
Coal blossom	1	561	
Sandy shale	29	590	
Coal blossom, Thacker	1	591	
Sandy shale	9	600	
Sandstone, massive	25	625	
Sandy shale	15	640	
Sandstone and sandy shale	85	725	
Coal blossom, Peerless	2	727	
Sandy shale and concealed	63	790	
Sandstone	40	830	
Coal blossom, No. 2 Gas	5	835	
Concealed	85	920	
Sandstone to creek, 1165' A. T. B.	50	970	970'

The **No. 2 Gas** and the **Winifrede coals** (locally called Coalburg) are mined at this point. The interval between these coals is 485 feet, and the interval between the Coalburg and the No. 2 Gas is 590 feet, and the **Stockton-Lewiston coal** is 738 feet above **No. 2 Gas,** showing an increase in thickness of the strata between these seams of 138 feet from that shown in the Eskdale section, 4 miles north of the Acme section. The interval between the No. 2 Gas seam at the Thistle mine and the Winifrede seam at the Rose mine of the Cabin Creek Consolidated Coal and Coke Company at Kayford is 473 feet, and the same interval is 485 feet at Acme.

The following section was measured by Krebs, descending from a high summit on the Raleigh-Kanawha county line, 2

miles south of Kayford, northward along county road to Kayford:

Section 2 Miles South of Kayford, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (260')			
Sandy shale and concealed	180	180	
Fire clay and slate, No. 5 Block	5	185	
Sandstone and concealed	75	260	260'
Kanawha Series (886')			
Sandstone and concealed, Homewood	100	360	
Fire clay and coal blossom	5	365	
Sandstone	35	400	
Coal blossom, Stockton	5	405	
Sandstone and concealed	180	585	
Coal blossom, Coalburg	5	590	
Sandstone	15	605	
Coal blossom	1	606	
Sandstone and concealed	99	705	
Coal blossom, Winifrede	5	710	
Sandstone and concealed	225	935	
Coal blossom, Cedar Grove	4	939	
Sandstone and concealed	171	1110	
Coal blossom, Peerless	3	1113	
Sandstone and concealed	27	1140	
Coal, No. 2 Gas	6	1146	1146'

The interval between the Winifrede coal and No. 2 Gas coal is 430 feet in the above section, and adding 25 feet for dip of the strata, as shown in the levels of the Winifrede seam, will make the interval 455 feet, while that between the Stockton and No. 2 Gas is 741 feet.

North Carbon is located 2 miles northeast of Kayford and on the strike of the coal between the two points. The following section was exposed by Mr. Charles Cabell, General Manager of the Carbon Coal Company, and taken with spirit level by W. E. James, Chief Engineer of said company, and later verified by Krebs, descending from a high summit westward to Cabin creek at Nabob P. O.:

Section at Nabob, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandstone and concealed	40	40
Coal blossom, Stockton-Lewiston	11	51
Sandstone, massive	57.26	108.26

		Thickness Feet.	Total Feet.
Coal, Coalburg		5.00	113.26
Sandstone and concealed		111.12	224.38
Coal, Winifrede		6.00	230.38
Sandstone and concealed		116.59	346.97
Coal, Chilton		3	349.97
Sandstone, massive		133.90	483.87
Coal, Thacker		1.1	484.97
Sandstone and concealed		100.48	585.45
Coal, Cedar Grove		2.11	587.56
Sandy shale and sandstone		121.37	708.93
Coal, Peerless		2.4	711.33
Sandstone and shale		23.04	734.37
Coal, No. 2 Gas		5.6	739.97
Sandstone		37.43	777.40
Coal, Powelton		0.60	778.00
Sandy shale		56.78	834.78
Coal		.30	835.08
Sandstone, massive		96.04	931.12
Coal, impure .....1.50 Limy shale .....2.00 Slate .....0.33 **Coal**, gas .....1.25 Fire clay .....1.25 **Coal**, gas .....1.62 Slate .....0.10 **Coal**, gas 2.50	**Eagle**	10.50	941.62
Sandstone, Decota		28.9	970.52
Coal, Little Eagle		2.5	973.02
Shale and concealed		4.98	978.00

The above section gives the interval between the No. 2 Gas and the top seam (called No. 5 Block by Mr. Cabell), but which the writer is inclined to believe is the Stockton-Lewiston 683.37 feet, while the bottom of the Eagle coal comes 201.15 feet lower, or 884.52 feet below the thick coal near the top of the section, and the interval between the Winifrede, called **Coalburg** by Mr. Cabell, and the **No. 2 Gas seam,** is 503.99 feet, compared with 485 feet at Acme, and 473 feet at Kayford.

The following section was measured by Teets from a high point, south of Decota, northward to Decota along the incline of the Cabin Creek Consolidated Coal & Coke Company:

Decota Section, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandstone, massive, East Lynn	140	140
Coal blossom, No. 5 Block	5	145
Sandstone, massive, Homewood	55	200
Coal blossom	2	202
Sandstone and concealed, **Kanawha Flint** horizon	28	230
Coal blossom, Stockton-Lewiston	1	231
Sandstone and concealed	124	355
Coal, good	1	356
Sandstone	14	370
Coal, Coalburg	5	375
Sandstone, massive	135	510
Concealed	10	520
Coal, blossom, Winifrede	1	521
Sandstone, massive, Lower Winifrede	89	610
Sandy shale and concealed	105	715
Coal blossom, Thacker	2	717
Sandstone and concealed	102	819
Coal blossom, Cedar Grove	3	822
Sandstone, massive	85	907
Concealed	40	947
Coal blossom, No. 2 Gas	5	952
Concealed	53	1005
Coal blossom, Powellton	1	1006
Concealed	100	1106
Coal, Eagle	3	1109
Sandstone, massive, Decota	25	1134
Coal, Little Eagle. Elev. 1129' A. T. L.	2	1136

The above section shows the interval between the No. 2 Gas coal and No. 5 Block, 802 feet, and No. 2 Gas and Lewiston 716 feet, and the No. 2 Gas and Coalburg 572 feet.

The following section was measured by Krebs, descending from a high summit northeastward to Cabin Creek, at Republic No. 5, 1.5 miles southeast of Carbon, Cabin Creek District:

Section 1.5 Miles Southeast of Carbon, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandy shale and concealed	120	120
Sandstone, massive	56	176
Coal .....0'-4"		
Slate .....0'-4" } **Upper Kittanning ?**	3'-8"	179'-8"
Coal .....3'-0"		
Sandstone, shelly with iron ore nuggets, East Lynn	73'-4"	253

	Feet. Thickness	Feet. Total
Slate	0'-6"	253'-6"
Coal ;..;....0'-4" / Slate .....0'-4" / Coal .....3'-0" / Fire clay ....0'-1½" / Coal, hard ....4'-0" — No. 5 Block.....	7'-9½"	261'-3½"
Sandstone, massive, medium coarse forming cliffs, Homewood	88'-8½"	350'-0"
Coal, hard, block	0'-2"	350'-2"
Sandstone and concealed	19'-10"	370'-0"
Slate	7'-0"	377'-0"
Coal .....1'-6" / Slate .....0'-2" / Coal bone ..1'-6" — Stockton-Lewiston.	3'-8"	380'-8"
Sandstone, massive, Coalburg	67'-4"	448'-0"
Coal, Coalburg	3	451'-0"
Sandstone	54	505'-0"
Coal, Winifrede. Coal ....2'-6" / Slate ....4'-0" / Coal ....1'-6" / Slate and fire clay ....4'-0" / Coal, hard block..5'-0"	17	522
Sandstone, massive and concealed	267	789
Slate	2'-4"	791'-4"
Coal, Thacker	0'-8"	792
Sandstone and concealed	28	820
Slate	10	830
Sandstone, shelly with coal mixed in same	70	900
Coal blossom, Cedar Grove	2	902
Sandstone and concealed	85	987
Coal blossom, Peerless	1	988
Sandstone and concealed	50	1038
No. 2 Gas Coal Coal ...2'-3" / Slate ...0'-2" / Coal ...2'-7"	5'-0"	1043
Sandstone and concealed	73	1116
Coal, Powellton	2	1118
Sandstone and concealed	80	1198

The above section shows the interval between the No. 2 Gas and Winifrede coal to be 516 feet, and the interval between the No. 2 Gas and the Coalburg coal to be 587 feet, and the interval between the No. 2 Gas and Stockton-Lewiston to be 658 feet, and the interval between the No. 2 Gas and No. 5 Block, 777 feet.

The following section was measured by Teets, descending from a high point just west of the mouth of Long Branch of Fifteen Mile Fork of Cabin creek, eastward to the mouth of Long Branch, at United Mine of Cabin Creek Consolidated Coal and Coke Company:

Section ½ Mile South of Wevaco, Cabin Creek District.

	Thickness Feet.	Total Feet.
Concealed	20	20
Sandstone, coarse	40	60
Sandstone, massive and concealed	129	189
Coal blossom, No. 5 Block	1	190
Sandstone, massive	30	220
Sandy shale and concealed	88	308
Coal blossom, Stockton-Lewiston	2	310
Sandstone, massive and concealed	105	415
Sandy shale and concealed	122	537
Coal, Winifrede. Coal, splint ...4'-9" / Slate ...0'-1" / Coal, splint ...1'-2"	6	543
Sandstone and concealed	162	705
Concealed	15	720
Sandstone and concealed	80	800
Concealed	10	810
Sandstone and concealed	110	920
Concealed	10	930
Sandstone and concealed	85	1015
Coal, No. 2 Gas. Coal, gas .4'-1" / Slate ....0'-1" / Coal ....0'-10"	5	1020
Sandstone and concealed	71	1091
Coal, Powelliton. Coal, good ..1'-0" / Slaty shale ....2'-0" / Coal, good ..1'-0"	4	1095
Sandstone, Decota, massive to creek. 1374' A. T. L.	11	1106

The above section gives the intervals between the No. 2 Gas coal, and the No. 5 Block, Stockton-Lewiston and Winifrede as 825 feet, 705 feet and 477 feet respectively. The Winifrede and No. 2 Gas coals are mined by the Cabin Creek Consolidated Coal & Coke Company at this point.

The following section was measured by Krebs, with aneroid, descending southward from a high summit on the Kanawha-Raleigh county line, 2 miles south of Wevaco to Fifteen Mile Fork of Cabin creek at mouth of Gibson Branch:

Section 2 Miles South of Wevaco, Cabin Creek District.

	Thickness Feet.	Total Feet.
Sandy shale and concealed	90	90
Coal blossom	1	91
Sandstone and concealed	89	180
Bench	...	180

	Thickness Feet.	Total Feet.
Sandstone, massive, Homewood	100	280
Coal blossom, Stockton-Lewiston	5	285
Sandstone and concealed	65	350
Coal blossom, Coalburg	5	355
Sandstone and concealed	130	485
Coal, Winifrede	8	493
Sandstone and concealed	77	570
Sandstone, massive	20	590
Sandstone and concealed	200	790
Coal blossom, Cedar Grove	...	790
Sandstone and concealed	160	950
Coal, Peerless. Coal .....0'- 4" / Slate .....0'-½" / Coal .....0'- 6" / Slate .....0'- 2" / Coal .....0'-10"	1'-9½"	951'-9½"
Sandstone and concealed	58'-2½"	1010
Coal, No. 2 Gas. 1525' A. T. B.	5	1015

The above section shows the interval between the No. 2 Gas Coal and the Stockton-Lewiston coal as 725 feet. The No. 2 Gas and the Winifrede coals are both mined here by the Cabin Creek Coal & Coke Co.

Keeferton is located on Paint Creek, Fayette county, about 4 miles southeast of Decota, and one mile east of the Kanawha-Fayette county line. There the Eagle coal is mined by the Solvay Colliery Company at 870 feet above the level of the railroad. A core drill hole was sunk at the mouth of Rattlesnake branch near Keeferton several years ago by the Gallego Land Company, and its record is combined with the outcropping rocks in the next section.

The following section was measured by Teets from a point about ½ mile northwest of Keeferton, eastward to Paint creek, and combined with the core drill hole sunk by the Gallego Land Company:

Section ½ Mile Northwest of Keeferton, Kanawha District, Fayette County.

	Thickness Feet.	Total Feet.
Kanawha Series (863')		
Sandstone and concealed	195	195
Coal blossom (old opening now fallen shut (**No. 2 Gas**)	3	198
Sandstone	117	315
Shale	3	318

		Feet. Thickness	Feet. Total	
Coal, Powellton.	Coal .....0'-7" Slate .....0'-2" Coal .....0'-3" Slate .....0'-1" Coal .....1'0" Coal, impure 0'-4" Coal .....0'-6" Slate .....0'-6" Coal, gas ....4'-7"	 8	326	
(Fire clay floor.)				
Sandstone and concealed		124	450	
(Sandstone roof.)				
Coal, Block .....4'-5" Slate .....0'-1" Coal, Gas .....2'-6"	Eagle	7	457	
Sandstone, sandy shale and concealed		183	640	
Coal blossom, Upper War Eagle		1	641	
Fire clay		4	645	
Slaty shale		5	650	
Sandstone and sandy shale		35	685	
Coal blossom, Middle War Eagle		3	688	
Sandstone massive		62	750	
Sandy shale		60	810	
Sandstone		20	830	
Sandy shale		30	860	
Coal blossom, Lower War Eagle		3	863	863'
Middle and Lower Pottsville (1075'-6")				
Sandstone, massive ...37' Sandy shale and sandstone .....102' Sandstone ..... 25' Sandy shale ..... 18' Sandstone, massive to top of core drill hole at mouth of Rattlesnake Branch of Paint Creek, thence with core drill hole .....160' Elevation top of hole 1210' A. T. B. Surface ..... 12' Slate ..... 14' Sandstone ..... 3'-2"	Nuttall Sandstone ..	371'-2"	1234'-2"	
Coal, Sewell		0'-10"	1235	
Sandstone		2	1237	
Sandy shale		6	1243	
Sandstone		16	1259	
Slate		1	1260	
Sandy shale		1'-11"	1261'-11"	
Dark shale		9	1270'-11"	
Sandy shale		1'-7"	1272'-6"	
Dark shale		2	1272'-6"	
Sandstone, hard, flinty		3'-4"	1277'-10"	

	Thickness Feet.	Total Feet.	
Sandy shale	1'-2"	1279	
Sandstone, hard broken	52	1331	
Dark sandy shale	8'-6"	1339'-6"	
Dark slate	7'-3"	1346'-9"	
Sandstone, hard, Upper Raleigh	43'-2"	1389'-11"	
Dark shale	0'-1"	1390	
Sandstone, hard, Lower Raleigh	70'-6"	1460'-6"	
Sandstone, conglomeratic, Lower Raleigh	7	1467'-6"	
Coal, dirty, Beckley	1	1468'-6"	
Sandstone, brown	4'-6"	1473	
Sandy shale, hard	9'-6"	1482-6"	
Dark sandy shale	14	1496'-6"	
Sandy shale, hard	29	1525'-6"	
Sandstone, hard	1	1526'-6"	
Sandy shale, hard	2	1528'-6"	
Sandstone, hard	4	1532'-6"	
Sandy shale, hard	3'-6"	1536	
Sandstone, hard	14	1550	
Sandstone, conglomeratic	11	1561	
Sandstone, hard	11	1572	
Sandstone, black shale and coal shells	56	1628	
Sandstone, conglomeratic	9	1637	
Dark shale	2	1639	
Sandstone, hard	3	1642	
Sandstone, conglomeratic	21	1663	
Dark shale	8'-6"	1671'-6"	
Sandy shale	2'-6"	1674	
Sandstone, hard	43	1717	
Blue shale	1	1718	
Sandstone, hard	35'-6"	1753'-6"	
Sandstone, conglomeratic	0'-6"	1754	
Sandstone, hard	4	1758	
Sandstone, conglomeratic	23	1781	
Sandstone, hard	21	1802	
Dark shale and coal	0'-4"	1802'-4"	
Shaly clay	0'-3"	1802'-7"	
Sandy shale	14'-11"	1817'-6"	
Dark shale	4'-3"	1821'-9"	
Shale and coal	1	1822'-9"	
Dark shale	2'-3"	1825	
Sandy shale	6	1831	
Sandstone	31	1862	
Sandstone with shale parting	1	1863	
Sandstone	30	1893	
Sandstone with slate seam	28'-6"	1921'-6"	
Sandstone	9'-6"	1931	
Sandstone, conglomeratic	0'-6"	1931'-6"	
Sandstone	7	1938'-6"	1075'-6"
Mauch Chunk Series (266'-6")			
Dark shale	9'-6"	1948	
Sandstone	2	1950	
Sandstone with shale spots	6	1956	
Sandstone	29	1985	

	Thickness Feet.	Total Feet.	
Dark and sandy shale	169	2154	
Sandstone, hard	11	2165	
Limestone, bastard, conchoidal	11	2176	
Lime and shale mixed	18	2194	
Red shale	3	2197	
Green lime	3	2200	
Red shale	5	2205	266'-6"

Adding 600 feet to the foregoing section for the upper portion of the Pottsville will make the thickness of the Pottsville series at this point about 2500 feet.

Powellton is located 6.5 miles north of Keeferton. About 12 years ago the Mt. Carbon Company, Limited, sunk a test well for oil and gas at that point, the record of which is published in Vol. I (A), page 502-503, West Virginia Geological Survey, 1904.

The following section was measured by Teets, descending from a high point east of Powellton, Kanawha District, Fayette county, 2 miles east of the Kanawha-Fayette county line, and joined on to the Powelton well No. 1.

Powellton Section, Kanawha District, Fayette County.

	Thickness Feet.	Total Feet.	
Allegheny Series (165')			
Sandstone, massive and concealed	145	145	
Concealed, No. 5 coal horizon	20	165	165'
Upper Kanawha Series (495')			
Sandstone, massive, Homewood	100	265	
Kanawha Black Flint	3	268	
Sandy shale and concealed	22	290	
Sandstone, massive	135	425	
Sandy shale	20	445	
Sandstone, massive	77	522	
Coal, Winifrede. Coal, gas .....0'-6" / Coal, bony .....0'-4" / Coal, splint .....2'-2"	3	525	
(Fire clay floor.)			
Sandy shale and concealed	40	565	
Sandstone, massive	95	660	495'
Lower Kanawha Series (675')			
Sandy shale	20	680	
Sandstone, massive	75	755	
Sandy shale	15	770	
Sandstone, massive	65	835	
Sandy shale	20	855	
Sandstone, massive	75	930	
Coal blossom (old opening fallen shut) **Powellton**	4	934	

	Thickness Feet.	Total Feet.	
Sandstone and concealed	96	1030	
Coal blossom, Eagle	3	1033	
Sandstone, massive	62	1095	
Sandy shale	25	1120	
Sandy shale	15	1195	
Sandstone and sandy shale	60	1180	
Sandstone and sandy shale	60	2255	
Sandy shale	30	2285	
Sandstone and concealed	50	1335	675'
Middle and Lower Pottsville Series (965')			
Sandstone, massive	60	1395	
Top of well drilled by the Mt. Carbon Coal Co. at Powellton. Elev. 925' A. T. B. Thence with well.			
Shale	48	1443	
Gray sandstone	18	1461	
Shale	1	1462	
Gray sandstone	14	1476	
Slate	2	1478	
White sand	195	1673	
Coal, Sewell	2	1675	
Sandstone	9	1684	
Shale	5	1689	
White, hard sand	11	1700	
Shale	40	1740	
Shale	265	2005	
Black, shaly lime	18	2023	
Gray lime	4	2027	
Buff colored and sandy lime	3	2030	
Sandstone	20	2033	
White, sandy lime	43	2076	
Black slate	3	2079	
Limestone	23	2102	
Sandstone, white and pebbly	93	2195	
Black shale and slate	50	2245	
Shale and sandy lime	6	2251	
Shale	6	2257	
Lime and slate	23	2280	
Pebbly and with gas	10	2290	965'
Mauch Chunk Shale (725')			
Clayey shale	9	2299	
Lime	13	2312	
Clayey shale	103	2415	
Brown shale	15	2430	
Lime	33	2463	
Red rock and limy shale	192	2655	
Lime, shell and slate	15	2670	
Red rock	50	2720	
Lime and shale pebbles	20	2740	
Lime	15	2755	
Red rock	48	2803	
Lime shell	7	2810	
Red rock, limy	60	2870	
Slate	21	2891	

	Thickness Feet.	Total Feet.	
Sandstone	34	2925	
Sandstone, hard black and white	22	2947	
Slate and lime shells	51	2998	
White limestone	3	3001	
Dark limestone	9	3010	
Slate, PENCIL CAVE	5	3015	725'
Greenbrier Limestone (156')			
Limy soil (top of Big Lime)	60	3075	
Slate	23	3098	
Gray lime	42	3140	
Mottled lime	13	3152	
Black shale, limy	4	3157	
Gray lime	14	3171	156'
Pocono Sandstones and Devonian Beds (939')			
Red sandy shale with various colored pebbles (top of Big Injun)	9	3180	
Fine, hard dark sand	5	3185	
Sandy shale, gradually growing into very fine hard sandstone	80	3265	
Gray, rotten water sand, coarse, open grained and pebbly	17	3282	
Shale, gradually growing to hard and impure limestone	73	3355	
Slate and shale to bottom	755	4110	939'

Some very interesting data is furnished in the preceding section. The thickness of the Pottsville Series is shown to be 2125 feet, being 835 feet thinner than at Keeferton. The top of the Big Lime is 2747 feet under the Kanawha Black Flint, and adding 800 feet the interval to the Pittsburgh coal, will make the Big Lime 3547 feet under the Pittsburgh coal at this locality, while the **Winifrede coal** is 360 feet under the **No. 5 Block** and 409 feet over the **Powellton coal.**

The following section was measured by Teets, descending from a high point one-half mile west of Hickory Camp, Fayette county, westward down a steep point to Hickory Camp, 0.2 mile east of Kanawha-Fayette county line:

Hickory Camp Section, Kanawha District, Fayette County.

	Thickness Feet.	Total Feet.
Kanawha Series (1540')		
Sandstone, Homewood, massive, medium coarse	70	70
Sandy shale	30	100
Sandstone, massive	30	130
Sandy shale and concealed	20	150
Sandstone, massive	40	190
Sandy shale	10	200

	Thickness Feet.	Total Feet.	
Sandstone, massive, Coalburg	70	270	
Sandy shale and concealed	30	300	
Sandstone, massive, Winifrede	50	350	
Sandy shale	10	360	
Coal blossom, Winifrede (old opening fallen shut)	8	363	
Sandstone, massive, medium coarse grained	75	438	
Sandy shale	17	455	
Sandstone, massive	50	505	
Sandy shale and concealed	30	535	
Sandstone, massive and concealed	50	585	
Shale, fossil plants	1	586	
Sandy shale	14	600	
Sandstone, massive	40	640	
Sandy shale and concealed	40	680	
Sandstone, massive	90	770	
Sandy shale	30	800	
Sandstone, massive	90	890	
Coal blossom, No. 2 Gas, (old opening fallen shut)	4	894	
Sandstone and concealed	116	1010	
Slate, draw	2	1012	
Powellton Coal, gas	4	1016	
(Slate floor.)			
Sandstone, massive	69	1085	
(Slate roof.)			
Eagle Coal. Coal 1'- 9" / Slate 1'- 5" / Coal, gas 2'-10"	6	1091	
(Slate floor.)			
Sandstone and concealed	69	1160	
Sandy shale	60	1220	
Shale	2	1222	
Sandstone, massive	58	1280	
Sandy shale	40	1320	
Sandstone, massive	65	1385	
Sandy shale and concealed	35	1420	
Sandstone, massive and concealed to C. & O. R. R. track at Hickory Camp, 910' A. T. B.	120	1540	1540'

The above section shows the interval between the **No. 2 Gas** and Winifrede coal to be 527 feet.

The following section was measured by Teets, descending from a ridge just west of Detroit station on Paint creek, eastward to the C. & O. R. R. track at Detroit:

Detroit Section, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (120')			
Sandstone and concealed	105	105	
Concealed	15	120	120'
Kanawha Series (975')			
Sandstone, massive, Homewood	80	200	
Coal 1'-0" / Sandstone 5'-0" / Coal blossom 4'-0" — **Stockton-Lewiston**	10	210	
Sandstone and concealed	70	280	
Slaty Cannel 2'-2" / Coal, splint 3'-10" — **Coalburg**	6	286	
Sandstone and concealed	124	410	
Concealed	15	425	
Sandstone	80	505	
Sandy shale	30	535	
Sandstone	50	585	
Sandy shale	70	655	
Sandstone, massive	128	783	
Coal blossom, No. 2 Gas	2	785	
Sandstone and concealed	121	906	
Coal, gas, Eagle	4	910	
Concealed to C. & O. R. R. track at 740' A. T. B.	185	1095	

The above section gives the interval between the **No. 2 Gas** and the **Coalburg** and **Stockton-Lewiston seams** to be 497 and 573 feet respectively.

The following section was measured by Teets, descending from a high point just east of Standard:

Standard Section, Cabin Creek District.

	Thickness Feet.	Total Feet.
Kanawha Series (840')		
Sandstone and concealed, Homewood	150	150
Concealed	20	170
Sandstone, sandy shale and concealed	105	275
Sandstone, massive, Coalburg	18	293
Slate, draw	0'-8"	293'-8"
Coalburg Coal. Coal, block 2'-4" / Coal, Cannel 2'-6" / Coal, gas (vis.) 1'-6"	6'-4"	300
Sandy shale	15	315
Sandstone, massive, Winifrede	110	425
Sandy shale and concealed	20	445
Sandstone, massive	45	490
Sandy shale, sandstone and concealed	50	540
Sandstone	60	600
Sandy shale	20	620
Sandstone	30	650

	Thickness Feet.	Total Feet.	
Sandy shale	60	710	
Coal blossom, Cedar Grove	2	712	
Sandstone, massive	88	800	
Shale	10	810	
Sandstone to C. & O. R. R. at 707' A. T. B.	30	840	840'

The **Kanawha Black Flint** was found 110 feet above the Coalburg, on the west side of Paint Creek about one mile north of Standard. This would make the interval between the **Cedar Grove Coal** and the **Kanawha Black Flint** about 520 feet at this point. The **Coalburg coal** is mined by the Standard Gas and Splint Coal Company at this point.

The following section was measured by Teets, descending from a high point about one mile southwest of Tomsburg, northeastward to C. & O. R. R. track one-half mile above mouth of Toms branch:

Section One Half Mile Southwest of Tomsburg.

Allegheny-Kanawha Series (1305')	Thickness Feet.	Total Feet.	
Sandstone and concealed	200	200	
Coal blossom, Stockton-Lewiston	2	202	
Sandy shale and concealed	70	272	
Coal blossom, prospect opening, Coalburg	3	275	
Sandstone and concealed	80	355	
Slate, draw	1	356	
Coal, Winifrede. { Coal, splint ....2'-4" / Slate .....0'-4" / Coal, splint ....3'-4" }	6	362	
(Fire clay floor.)			
Sandstone, massive	193	555	
Coal blossom, Thacker	2	557	
Sandy shale	8	565	
Sandstone and sandy shale	70	635	
Concealed	20	655	
Sandstone, massive	90	745	
Sandy shale and sandstone	125	870	
Coal blossom, No. 2 Gas	3	873	
Sandstone, massive	132	1005	
Coal, good, Eagle	4	1009	
Sandstone, massive	96	1105	
Sandy shale and concealed to 810' A. T. B.	200	1305	1305'

The interval between the **Winifrede coal** and **No. 2 Gas coal** is 508 feet in the above section.

The following section was measured by Teets, descending

from a high point about one mile southeast of Wacoma, southwest to Left Branch of Paint creek at Banner mine:

Section 1.2 Miles Southeast of Wacoma, Cabin Creek District.

		Thickness Feet.	Total Feet.	
Allegheny-Kanawha Series (730')				
Sandstone and concealed		150	150	
Kanawha Black Flint		4	154	
Concealed		22	176	
Coal blossom, Stockton-Lewiston		3	179	
Sandstone and concealed		98	277	
Slate, draw .....0'-6"				
Coal, block .....4'-1"				
Bone .....0'-2"	**Coalburg**	7	284	
Coal .....1'-1"				
Slate .....0'-2"				
Coal, gas .....1'-0"				
Sandy shale and concealed		101	385	
Sandstone		40	425	
Sandy shale		10	435	
Sandy shale and concealed		150	585	
Concealed		25	610	
Sandstone and concealed		88	698	
Coal blossom, Cedar Grove		2	700	
Sandstone to bed of branch at 805' A. T. B.		30	730	730'

The above section shows the **Coalburg coal** is 123 feet under the Kanawha Black Flint, and that the **Cedar Grove** coal is 544 feet under same horizon.

The following section was measured by Krebs, descending from a high point east of Mucklow, and combined with the Paint Creek Coal & Land Company's Well No. 1 (616), located just east of Mucklow:

Mucklow Section, Cabin Creek District.

		Thickness Feet.	Total Feet.
Allegheny-Kanawha Series (960')			
Sandstone and concealed		200	200
Kanawha Black Flint		5	205
Concealed		34	239
Coal blossom, Stockton-Lewiston		1	240
Sandstone and concealed		70	310
(Sandstone.)			
Slate, draw .....1'-0"			
Coal, block .....4'-4"			
Coal, bony .....0'-4"	**Coalburg**	10	320
Coal, block .....2'-6"			
Slate .....0'-9"			
Coal .....1'-1"			
(Slate floor.)			

	Thickness Feet.	Total Feet.	
Sandstone and concealed	60	380	
Coal blossom, Winifrede	2	382	
Sandstone, massive	73	455	
Coal blossom, Chilton	1	456	
Sandstone and concealed	84	540	
Concealed	30	570	
Coal blossom, Thacker	2	572	
Concealed	118	690	
Coal blossom, Cedar Grove	1	691	
Sandstone and concealed to top of bore hole at 740' A. T. B.	9	700	
Unrecorded	12	712	
Flint rock	30	742	
Sand	198	940	
Slate	20	960	960'
Middle and Lower Pottsville (890')			
Sand	680	1640	
Slate	15	1655	
Sand	195	1850	890'
Mauch Chunk Red Shale (510')			
Slate	40	1890	
Red rock	150	2040	
Lime	20	2060	
Slate	60	2120	
Red rock	20	2140	
Lime	26	2166	
Sand	34	2200	
Slate	20	2220	
Sand, Maxton	70	2290	
Little lime	30	2320	
Slate	20	2340	
Lime	15	2355	
Pencil Cave	5	2360	510'
Greenbrier Limestone (235')			
Black lime	15	2375	
Slate and shells	50	2425	
Big lime	170	2595	235'
Pocono Sandstones (494')			
Sand, red, Big Injun	45	2540	
Slate	20	2660	
Sand, Squaw	65	2725	
Sand and slate	40	2765	
Sand	47	2812	
Slate, dark	208	3020	
Slate, black	30	3050	
Sand, Berea	39	3089	494'
Slate	63	3152	63'

The above section gives the interval between the Kanawha Black Flint and top of Big Lime, 2155 feet, as compared with 2817 feet in the Powellton Section, located 7 miles southeastward, showing that the measures have thickened 662 feet in that distance, or about 95 feet per mile.

The following section was measured by Krebs, descending from a high point westward into Staten run, one mile northwest of Montgomery, Cabin Creek district:

Section ½ Mile Northwest of Montgomery, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (140')			
Sandstone and concealed	135	135	
Coal blossom, No. 5 Block	5	140	140'
Kanawha Series (820')			
Sandstone, massive, Homewood	115	255	
Kanawha Black Flint	5	260	
Sandy shale	10	270	
Coal blossom, Stockton-Lewiston	5	275	
Sandstone and concealed	35	310	
Sandy shale	5	315	
Sandstone and concealed	110	425	
Sandy shale	5	430	
Sandstone and concealed	143	573	
Coal blossom, Thacker	2	575	
Sandstone and concealed	110	685	
Coal blossom, Cedar Grove	1	686	
Concealed	4	690	
Sandstone, massive	40	730	
Sandy shale and concealed	60	790	
Coal blossom, Peerless	2	792	
Sandy shale and concealed	30	822	
Coal, No. 2 Gas	5	827	
Sandstone and concealed	35	862	
Coal 1'-6" / Fire clay 2'-0" / Coal 0'-6" — **Powellton**	4	866	
Shale and sandstone	35	901	
Limestone, Cannelton	2	903	
Sandy shale and concealed	35	938	
Coal blossom, Eagle	2	940	
Concealed to Kanawha River	20	960	960'

The above section shows the interval between the **No. 2 Gas Coal** and **Kanawha Black Flint** to be 562 feet.

The following section was measured from a high point south of the mouth of Sugar Camp Branch ot Paint Creek.

Section 1.2 Miles South of Holly Grove, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (120')			
Sandstone, massive, East Lynn	100	100	
Concealed	20	120	120'

	Thickness Feet.	Total Feet.	
Kanawha Series (660')			
Sandstone and concealed, Homewood	100	220	
Kanawha Black Flint	5	225	
Sandy shale and concealed	35	260	
Sandstone, Coalburg	60	320	
Sandy shale and concealed	20	340	
Sandstone, massive	40	380	
Sandy shale and concealed	20	400	
Sandstone	70	470	
Concealed	40	510	
Sandstone and concealed	90	600	
Concealed	25	625	
Sandy shale and concealed	25	650	
Concealed	50	700	
Sandstone and concealed to level of Paint Creek, at 620' A. T. L.....	80	780	660'

The above section shows the Kanawha Black Flint at 555 feet above the level of Paint creek.

Crescent is located one mile east of Montgomery and just south of the Kanawha-Fayette county line. The **No. 5 Block,** the **No. 2 Gas** and the **Eagle** coals are mined here by the W. R. Johnson Coal Company.

The following section was measured by Teets with aneroid, descending from a point just west of Crescent, Kanawha district, Fayette county, 0.3 mile south of the Kanawha-Fayette county line, eastward to Crescent:

Crescent Section, Kanawha District, Fayette County.

	Thickness Feet.	Total Feet	
Allegheny Series (195.5')			
Sandstone, massive	80	80	
Sandy shale	10	90	
Sandstone, massive, East Lynn	100	190	
Coal, splint—block.....0'- 8"			
Coal, gas (vis.).....0'-10" } No. 5			
Slate .....0'- 1" | Block	5'-6"	195'-6"	195.5
Coal, splint—block.....3'-11"			
Kanawha Series (909.5')			
Sandstone and concealed, Homewood	70'-6"	266	
Kanawha Black Flint	4	270	
Shale and sandstone	10	280	
Coal blossom (old opening shut) Stockton-Lewiston	3	283	
Sandy shale and concealed	42	325	
Sandstone, massive, Coalburg	80	405	
Sandy shale and concealed	15	420	
Sandstone, massive, cliff rock	60	480	
Concealed	45	525	

		Thickness Feet.	Total Feet.	
Coal blossom, Winifrede		2	527	
Sandstone, Lower Winifrede		38	565	
Sandy shale and concealed		15	580	
Sandstone, massive		75	655	
Coal blossom, Thacker		1	656	
Sandy shale and concealed		64	720	
Sandstone and concealed		70	790	
Sandy shale		20	810	
Sandstone, massive		70	880	
Coal, Peerless		1.5	881.5	
Sandy shale		9.5	891	
Coal, gas 1'-0"				
Slate, black 0'-2"				
Coal, gas 0'-7"	**No. 2 Gas**	5	896	
Coal, splint 0'-2"				
Coal, gas 3'-1"				
(Slate floor.)				
Sandy shale and concealed		124	1020	
Shale		3	1023	
Coal 0'-11"				
Slate 0'- 3"	**Eagle**	4	1027	
Coal 2'-10"				
Fire clay		4	1031	
Sandstone, massive (Decota)		19	1050	
Shale		4	1054	
Coal, Little Eagle		2	1056	
Sandstone and concealed to 640' A. T. B.		49	1105	909.5'

The above section shows the interval between the **No. 2 Gas Coal** and the **Kanawha Black Flint** to be 627 feet at this locality.

Another section was measured by Teets, descending from a high point one-half mile west of Elk Ridge, Kanawha district, Fayette county, and about one mile east of the Kanawha-Fayette county line, eastward along trail to Elk Ridge P. O.:

Elk Ridge Section, Kanawha District, Fayette County.

	Thickness Feet.	Total Feet.	
Allegheny Series (125')			
Sandstone and concealed	125	125	125'
Kanawha Series (1060')			
Sandstone, massive, Homewood	95	220	
Kanawha Black Flint	3	223	
Sandstone and sandy shale	102	325	
Coal blossom, Coalburg	1	326	
Sandy shale and sandstone	99	425	
Sandy shale	20	445	
Sandstone	60	505	
Sandy shale	20	525	
Sandstone and concealed	50	575	
Sandy shale	25	600	

		Thickness Feet.	Total Feet.	
Sandstone		75	675	
Sandy shale		15	690	
Sandstone and concealed		135	825	
Sandy shale		20	845	
Sandy shale and concealed		84	929	
Sandy shale		5	934	
Coal ....0'-7"				
Slate, gray ....0'-4"				
Coal, gas ....2'-4"				
Slate, black ....0'-1"	Powellton	6	940	
Coal ....0'-9"				
Slate, gray ....0'-2"				
Coal ....1'-9"				
Sandstone, massive		70	1010	
Coal blossom, Eagle		3	1013	
Sandstone and concealed		77	1090	
Concealed		10	1100	
Sandstone, massive		100	1200	
Sandy shale		5	1205	1080'
Middle Pottsville Series (100')				
Sandstone, massive		45	1250	
Sandy shale		30	1280	
Sandstone, massive to C. & O. R. R. level at Elk Ridge. Elev. 1000' A. T. B.		25	1305	100'

The above section gives the interval between the **Coalburg coal** and **Powellton coal,** 608 feet, and that between the **Kanawha Black Flint** and **Powellton coal,** 711 feet.

The following section was measured by Teets, descending eastward from a high point to the C. & O. R. R., one mile southeast of Pratt:

Section One Mile Southeast of Pratt, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (120')			
Sandstone, massive, East Lynn	100	100	
Sandy shale	20	120	120'
Kanawha Series (655')			
Sandstone, massive, Homewood	70	190	
Kanawha Black Flint	5	195	
Concealed and sandstone	157	352	
Coal blossom, Winifrede	3	355	
Sandstone, massive	85	440	
Sandy shale and concealed	35	475	
Sandstone, massive	50	525	
Sandy shale	20	545	
Sandstone, massive	70	615	
Sandy shale	8	623	
Coal blossom, Cedar Grove	2	625	
Coal blossom, No. 2 Gas	5	725	
Sandstone and concealed to C. & O. R. R. at 640' A. T. B.	50	775	775'
Sandstone and concealed	95	720	

The above section shows the interval between the Kanawha Black Flint and the No. 2 Gas coal 525 feet, and that between the No. 2 Gas coal and the Winifrede coal, 365 feet.

In Volume II., W. Va. Geol. Sur., on page 373 Dr. White has published an interesting section, showing the succession of the rocks in the Kanawha series at Handley.

The writer has taken a section from a high summit at Handley and joined onto the section.

Section from a high point descending the hill eastward to the Chesapeake Mining Company's (formerly Wyoming Coal Company) mines at a point one-half mile west of Handley:

Section One-Half Mile West of Handley, Cabin Creek District.

		Thickness Feet.	Total Feet.	
Allegheny Series (203')				
Sandstone and concealed		130	130	
Sandstone, massive, East Lynn		70	200	
Coal blossom, No. 5 Block		3	203	203'
Kanawha Series (776')				
Sandstone and concealed, Homewood		82	285	
Kanawha Black Flint		5	290	
Shales and concealed		50	340	
Coal, splint ....2'-0"				
Coal, soft .....0'-4"				
Coal, slaty .....1'-0"				
Coal, splint .....1'-4"				
Coal and slate ....4'-2½"	**Stockton-**			
Slate .....0'-9"	**Lewiston.**	12'-1"	352'-1"	
Coal, splint ....0'-9½"				
Coal, slaty .....0'-1"				
Coal, soft .....1'-7"				
Concealed		30	382'-1"	
Coal, splint .....0'-10"				
Nigger head .....0'- 3"	**Coalburg.**	4'-10"	386'-11"	
Coal, splint .....3'- 9"				
Concealed and massive sandstone		53'-6"	440'-3"	
Coal .....0'-6"				
Rock .....0'-6"	Local	1'-6"	441'-11"	
Coal .....0'-6"				
Shales and sandstone		20'-1"	462	
Coal, splint .....3'-6"				
Slate .....0'-2"				
Coal .....0'-6"	**Winifrede**	5'-3"	467'-3"	
Dark rock .....0'-4"				
Coal .....0'-9"				
Concealed		370'-9"	838'-0"	
Coal, Peerless		2	840	
Concealed		25	565	
Coal, No. 2 Gas		4	869	
Concealed to Kanawha river, 587' A. T. B..		85	954	
Interval to Eagle		25	979	776'

The above section shows all the important coals in the Kanawha series except the **Thacker, Powellton** and **Cedar Grove** seams.

The interval between the **No. 2 Gas** and the **Kanawha Black Flint** and the **Winifrede** are respectively 575 feet and 397.75 feet.

Another section was measured descending from a high point on the Kanawha-Boone county line along road descending into White Oak creek, Sherman district, Boone county, 5 miles west of Red Warrior P. O., Sherman district, Boone county:

Section 5 Miles West of Red Warrior P. O., Sherman District, Boone County.

	Thickness Feet.	Total Feet.	
Allegheny Series (162')			
Sandy shale and concealed	44	44	
Coal blossom	1	45	
Sandy shale and concealed	30	75	
Fire clay	2	77	
Sandstone and concealed, East Lynn	83	160	
Fire clay and coal blossom, No. 5 Block	2	162	162'
Kanawha Serics (658')			
Sandstone, massive, Homewood	128	290	
Coal blossom, Stockton	5	295	
Sandstone and concealed, Coalburg	50	345	
Coal blossom, Coalburg	2	347	
Sandstone and concealed	113	460	
Coal blossom, Winifrede	5	465	
Sandstone and concealed	60	525	
Coal blossom, Chilton	2	527	
Sandstone and concealed	103	630	
Coal blossom, Thacker	1	631	
Sandstone and concealed	144	775	
Coal 1'-0" Slate 0'-2" } Local Coal 0'-8"	1'-10"	776'-10"	
Sandstone and concealed	18'-2"	795	
Coal, Cedar Grove	3	798	
Sandy shale to White Oak creek	22	820	658'
Interval to No. 2 Gas coal	148	968	

The above section gives the interval between the **No. 2 Gas coal** and **Cedar Grove** 170 feet, compared with the interval as given in a core drill hole at mouth of Haggle creek, Sherman district, Boone county, as 165 feet, and 169 feet on Laurel Fork of Coal Fork on a previous page of this volume. This section also gives the interval between the **No. 2 Gas** and **Winifrede**

coals 503 feet, and that between the **No. 2 Gas** and **No. 5 Block** as 806 feet.

The following section was measured by Krebs with aneroid, descending from a high point on the Kanawha-Boone county line, northwestward along the county road to Lens creek, 3 miles southwest of Hernshaw:

Section 3 Miles Southwest of Hernshaw, Loudon District.

	Thickness Feet.	Total Feet.	
Allegheny Series (160')			
Sandstone and concealed	150	150	
Sandy shale, **No. 5 Block coal horizon**	10	160	160'
Kanawha Series (493')			
Sandstone and concealed	65	225	
Sandstone, massive	30	255	
Black slate, **Kanawha Black Flint horizon**	5	260	
Sandy shale and concealed	155	415	
Coal blossom, Winifrede	5	420	
Sandstone and concealed	50	470	
Sandy shale and concealed	180	650	
Coal, Cedar Grove. 840' A. T. B.	3	653	653'

The above section shows the interval between the Winifrede and Cedar Grove coals to be 230 feet, and that between the Winifrede and No. 5 Block, 260 feet, compared with 287 feet at Winifrede P. O. section, on a previous page of this volume.

The following section was measured by Krebs, with aneroid, descending southward from a high hill on the Kanawha-Boone line to Trace Fork of Left Fork of Joe's creek, 3 miles southwest of Winifrede, Sherman district, Boone county, and just south of the Kanawha-Boone county line:

Section 3 Miles Southwest of Winifrede, Sherman District, Boone County.

	Thickness Feet.	Total Feet.	
Allegheny Series (152')			
Sandstone	18	18	
Fire clay	2	20	
Sandy shale and sandstone, East Lynn	130	150	
Fire clay and slate, **No. 5 Block horizon**	2	152	152'
Kanawha Series (598')			
Sandy shale and sandstone	51	203	
Fire clay	2	205	
Sandstone and conglomerate, Homewood	75	280	
Fire clay and sandstone	2	282	
Sandy shale and sandstone	150	432	
Coal blossom, Winifrede	3	435	

	Thickness Feet.	Total Feet.	
Sandstone and concealed	55	490	
Sandstone, massive	78	568	
Coal blossom, Thacker	2	570	
Sandy shale and sandstone	83	653	
Coal blossom, Cedar Grove	2	655	
Sandstone and concealed to 810' A. T. B.	95	750	750'

The interval between the **Winifrede** and the **No. 5 Block** coals is 280 feet in the above section.

Another section was taken by Krebs, descending from a high summit northward on the Kanawha-Boone county line into Fields creek, 2 miles south of Winifrede, Cabin Creek district:

Section 2 Miles South of Winifrede, Cabin Creek District.

	Thickness Feet.	Total Feet.	
Allegheny Series (182')			
Sandy shale and sandstone, Mahoning	30	30	
Fire clay	2	32	
Sandy shale and sandstone	28	60	
Sandstone	30	90	
Sandy shale and concealed	70	160	
Sandstone, massive, East Lynn	20	180	
Coal blossom, No. 5 Block	2	182	182'
Kanawha Series (478')			
Sandy shale and sandstone, Homewood	98	280	
Coal blossom, Stockton-Lewiston	5	285	
Sandstone and concealed	75	360	
Fire clay	5	365	
Sandstone and concealed	55	420	
Coal blossom, Coalburg	2	422	
Sandstone, massive, Winifrede	73	495	
Coal, Winifrede	5	500	
Sandstone, massive, Lower Winifrede	55	555	
Coal blossom, Chilton	2	557	
Sandstone and concealed	103	660	478'

The above section shows the interval between the **Winifrede** and **No. 5 Block** coals to be 313 feet, and that between the **Winifrede** and the **Stockton-Lewiston,** 210 feet, compared with 422 feet, and 260.5 feet between the same coals in the section at High Coal, Boone county, given on a previous page of this volume.

The following section was obtained in the scutheastern corner of Washington district by Teets, descending from a high point one mile east of Dungriff, southward to Brush Fork of Brier creek:

Section One Mile East of Dungriff, Washington District.

	Thickness Feet.	Total Feet.	
Allegheny Series (83')			
Sandy shale	30	30	
Sandstone, massive, coarse, East Lynn...	52	82	
Fire clay, No. 5 Block coal horizon.....	1	83	83'
Kanawha Series (292')			
Sandy shale, sandstone and concealed	130	213	
Coal blossom, Stockton-Lewiston	2	215	
Sandstone, Coalburg	60	275	
Sandy shale and sandstone	80	355	
Coal, gas .....0'-4" } **Winifrede**			
Coal, gray splint, bony 0'-3" } (Black ..	4	359	
Coal, splint .....3'-5" } Band).			
Fire clay floor, and concealed to bed of creek at 940' A. T. B.....	16	375	292'

The above section shows the interval between the **Winifrede** and the **Stockton-Lewiston coal** at this point as 140 feet. The **Winifrede coal** is mined at Dungriff and at Olcott and is called locally the "Black Band Coal."

The following section was measured by Krebs, descending from a high summit on the Boone-Kanawha county line, southward to Davis creek, one mile south of Chilton:

Section One Mile South of Chilton, Loudon District.

	Thickness Feet.	Total Feet.	
Allegheny Series (177')			
Sandy shale	20	20	
Sandstone, massive	75	95	
Fire clay	5	100	
Sandstone, conglomeratic, massive, East Lynn	75	175	
Fire clay and coal blossom (No. 5 Block coal)	2	177	177'
Kanawha Series (263')			
Sandstone, massive, Homewood	63	240	
Sandy shale, iron ore, Black Band, Kanawha Black Flint horizon	5	245	
Sandstone and concealed	115	360	
Coal blossom, Coalburg	2	362	
Sandstone and concealed	48	410	
Slate	1	411	
Coal, splint, Winifrede	2'-6"	413'-6"	
Slate	1'-6"	415	
Sandstone, Lower Winifrede. Elev. 835' A. T.	25	440	263'

The following section was measured by Teets, descending

from a high point on divide between Left Fork and Meadow Fork to the southwest, along county road to mouth of Left Fork of Meadow Fork:

Section 1.5 Miles North of Olcott, Washington District.

	Thickness Feet.	Total Feet.	
Allegheny Series (182')			
Concealed	30	30	
Sandstone and concealed	40	70	
Sandy shale and concealed	38	108	
Fire clay	2	110	
Sandstone, massive. East Lynn	70	180	
Coal blossom, No. 5 Block	2	182	182'
Upper Pottsville or Kanawha Series (228')			
Sandy shale and sandstone, Homewood	106	288	
Coal blossom, Stockton-Lewiston	2	290	
Sandy shale and sandstone, Coalburg	67	357	
Coal blossom, Coalburg	3	360	
Sandstone, massive, medium coarse, Winifrede	36	396	
Coal, Winifrede	4	400	
Sandstone, massive to 850' A. T. B.	10	410	410'

The **Winifrede coal** is mined at Olcott by the Lackawanna Coal and Lumber Company and is known as the "Black Band Coal."

The following section was mesured by Teets, from a point ½ mile northeast of the Kanawha-Boone county line, also corner of Washington and Loudon districts of Kanawha county, northwest along county road to head of Davis creek:

Section 2 Miles Northwest of Hernshaw, Loudon District.

	Thickness Feet.	Total Feet.	
Conemaugh and Allegheny Series (242')			
Sandstone and concealed	115	115	
Sandstone, massive, coarse	80	195	
Slaty shale	2	197	
Sandstone and concealed	43	240	
Coal, No. 5 Block	2	242	242'
Upper Kanawha Series (253')			
Sandstone and concealed, Homewood	98	340	
Sandy shale, **Kanawha Black Flint horizon**	10	350	
Sandstone and concealed	36	386	
Coal and slate, Coalburg	4	390	
Sandstone and concealed	102	492	
Coal, Winifrede Black Band at 1120' A. T. B.	3	495	253'

The **Winifrede Coal** was formerly mined about ½ mile

south of this on Davis creek by the Black Band Coal Company.

The following section was measured with aneroid by Teets descending from a high summit between White Oak creek and Coal river, westward to Coal river, at mouth of Packs Branch, 4 miles south of the Boone-Kanawha county line, and 3.3 miles southeast of Orange P. O.:

Section 3.3 Miles Southeast of Orange P. O., Sherman District, Boone County.

		Thickness Feet.	Total Feet.	
Kanawha Series (775')				
Sandstone and concealed ..... (Sandstone roof.)		100	100	
Slate, gray .....0'-2"				
Coal .....1'-7"				
Slate, dark .....0'-3"	**Stockton-**			
Coal, splint .....2'-3"	**Lewiston..**	6	106	
Slate, gray .....0'-4"				
Coal (vis.) .....1'-5"				
Sandstone, massive		34	140	
Coal, prospect opening fallen in.....		2	142	
Sandstone, massive		83	225	
Coal, prospect opening fallen in, **Coalburg**		3	228	
Sandstone and concealed		320	548	
Coal, Cedar Grove, reported		3	551	
Sandstone and concealed		149	700	
Coal .....0'-7"				
Slate, dark .....0'-5"				
Coal, good, glossy black .....2'-6"	**No. 2 Gas..**	5	705	
Slate .....0'-4"				
Coal, reported .....1'-2"				
Sandstone, massive		45	750	
Coal, good, Powellton		2.7	752.7	
Sandstone to bed of Coal river at 760' A. T. B.		22.3	775	775

The above section shows the interval between the **Stockton-Lewiston** and **No. 2 Gas Coal** to be 594 feet.

The following section was measured by Teets from a high point just east of Diamond station on the K. & M. railroad, westward down the hill to K. & M. railroad level at Diamond:

Diamond Section, Cabin Creek District.

Kanawha Series (720')	Thickness Feet.	Total Feet.	
Sandstone, massive, medium coarse, forms great cliff	70	70	
Sandy shale and concealed	10	80	
Sandstone	55	135	
Kanawha Black Flint	3	138	
Sandy shale	10	148	
Coal blossom, Stockton-Lewiston	2	150	
Sandstone, massive cliff	100	250	
Sandy shale and concealed	15	265	
Sandstone, massive	50	315	
Sandy shale and concealed	40	355	
Coal, Winifrede, abandoned opening, reported	5	360	
Sandy shale, sandstone and concealed	315	675	
Coal, Peerless (abandoned opening)	3	678	
Concealed to railroad track at 615' A. T. B.	42	720	720'

The above section shows the interval between the **Kanawha Black Flint** and **Winifrede** coal 217 feet, and that between the **Winifrede** and the **Peerless coals,** 315 feet. The **Winifrede** coal was once mined here; but the mine is now abandoned.

The following section was measured by Teets from a point ¼ mile east of the Kanawha river and ¾ mile north of mouth of Simmons creek westward down hill to Piatt station on the K. & M. railroad opposite Marmet:

Piatt Section, Malden District.

Upper and Lower Kanawha Series (800')	Thickness Feet.	Total Feet.
Sandy shale	37	37
Kanawha Black Flint	3	40
Coal and shale, Stockton-Lewiston	5	45
Sandstone, medium coarse, big cliff	70	115
Sandstone and concealed	10	125
Sandstone, massive, medium coarse	45	170
Concealed and sandstone	40	210
Sandstone, massive	40	250
Sandy shale and concealed	30	280
Sandstone, massive, fine grained	35	315
Sandy shale and concealed	45	360
Sandstone, massive, fine grained	90	450
Sandy shale	10	460
Coal blossom, Cedar Grove	2	462
Sandy shale and concealed	83	545
Sandstone, massive cliff rock	40	585
Coal blossom, No. 2 Gas	1	586

	Thickness Feet.	Total Feet.	
Sandstone, massive, Brownstown	40	626	
Concealed	30	656	
Coal blossom, Powelton	1	657	
Sandstone and concealed to river at 587' A. T. B.	143	800	800'

The above section shows the interval between the **No. 2 Gas coal** and **Kanawha Black Flint** to be 545 feet at this point.

The following section was measured by Teets from a high point, ½ mile southeast of Bell station on the K. & M. railroad, westward to railroad level, ½ mile southeast of Bell:

Section 0.5 Mile Southeast of Bell, Malden District.

Kanawha Series (760')	Thickness Feet.	Total Feet.	
Sandstone, massive cliff, Homewood	75	75	
Sandy shale and concealed	15	90	
Kanawha Black Flint	4	94	
Sandstone, massive cliff	101	195	
Sandstone and concealed	50	245	
Sandstone	40	285	
Sandy shale and concealed	60	345	
Sandstone	20	365	
Sandy shale and concealed	70	435	
Sandstone	40	475	
Sandy shale and concealed	70	545	
Sandstone, massive	65	610	
Sandy shale and concealed	14	624	
Coal blossom, No. 2 Gas	1	625	
Sandstone, massive	50	675	
Sandy shale and concealed	24	699	
Coal blossom, Eagle	1	700	
Sandstone, massive	45	745	
Sandy shale and concealed to railroad at 615' A. T. B.	15	760	760'

The above section shows the interval between the **No. 2 Gas** and **Kanawha Black Flint** to be 530 feet at this point.

The following section was measured from a point high on a hill westward to railroad level at Ward:

Ward Section, Cabin Creek District.

Kanawha Series (510')	Thickness Feet.	Total Feet.
Sandstone, massive, Homewood	60	60
Concealed	15	75
Kanawha Black Flint	5	80
Sandstone and concealed	75	155

		Thickness Feet.	Total Feet.	
Coal, soft .....1'-2" Coal, bone .....0'-2" Coal, hard, block ....1'-1" Coal, bone .....0'-4" Coal, block .....2'-3"	**Coalburg**	5	160	
Concealed		60	220	
Sandstone, massive, medium coarse, Winifrede		60	280	
Sandy shale		20	300	
Sandstone and concealed		50	350	
Sandstone, massive		45	395	
Sandy shale and concealed		25	420	
Sandstone and concealed		50	470	
Sandstone, massive		30	500	
Shale		5	505	
Coal, soft .....1'-4" Coal, hard, block ....1'-8"	**Cedar Grove**	3	508	
Fire clay to 715' A. T. L.		2	510	510'

The above section shows the interval between the **Coalburg** and **Cedar Grove coal** 345 feet, and between the **Kanawha Black Flint** and **Cedar Grove coals,** 428 feet.

The following section was measured by Teets from a high point, ¾ mile west of Blakeley, northeastward down the road to a point on Morris Fork, one mile west of Blakeley:

Section 1 Mile West of Blakely, Elk District.

		Thickness Feet.	Total Feet.	
Allegheny Series (151')				
Sandstone and concealed (shale roof)		65	65	
Coal, gas .....1'-3" Coal, bone .....0'-4" Coal, block .....3'-5"	**No. 5 Block.**	5	70	
Sandy shale		10	80	
Sandstone, massive, medium coarse		60	140	
Sandy shale		10	150	
Coal blossom, Clarion		1	151	151'
Kanawha Series (140')				
Sandstone		9	160	
Sandy shale and concealed		30	190	
Sandstone, massive, coarse and concealed, Homewood		60	250	
Kanawha Black Flint		2	252	
Concealed		38	290	
Coal blossom, Stockton-Lewiston, and concealed to bed of stream, at 1045' A. T. B.		1	291	140'

DESCRIPTION OF THE POTTSVILLE FORMATIONS.

The Upper Kanawha Series.

The several formations of the Upper Kanawha Series will now be described in detail.

The Homewood Sandstone.

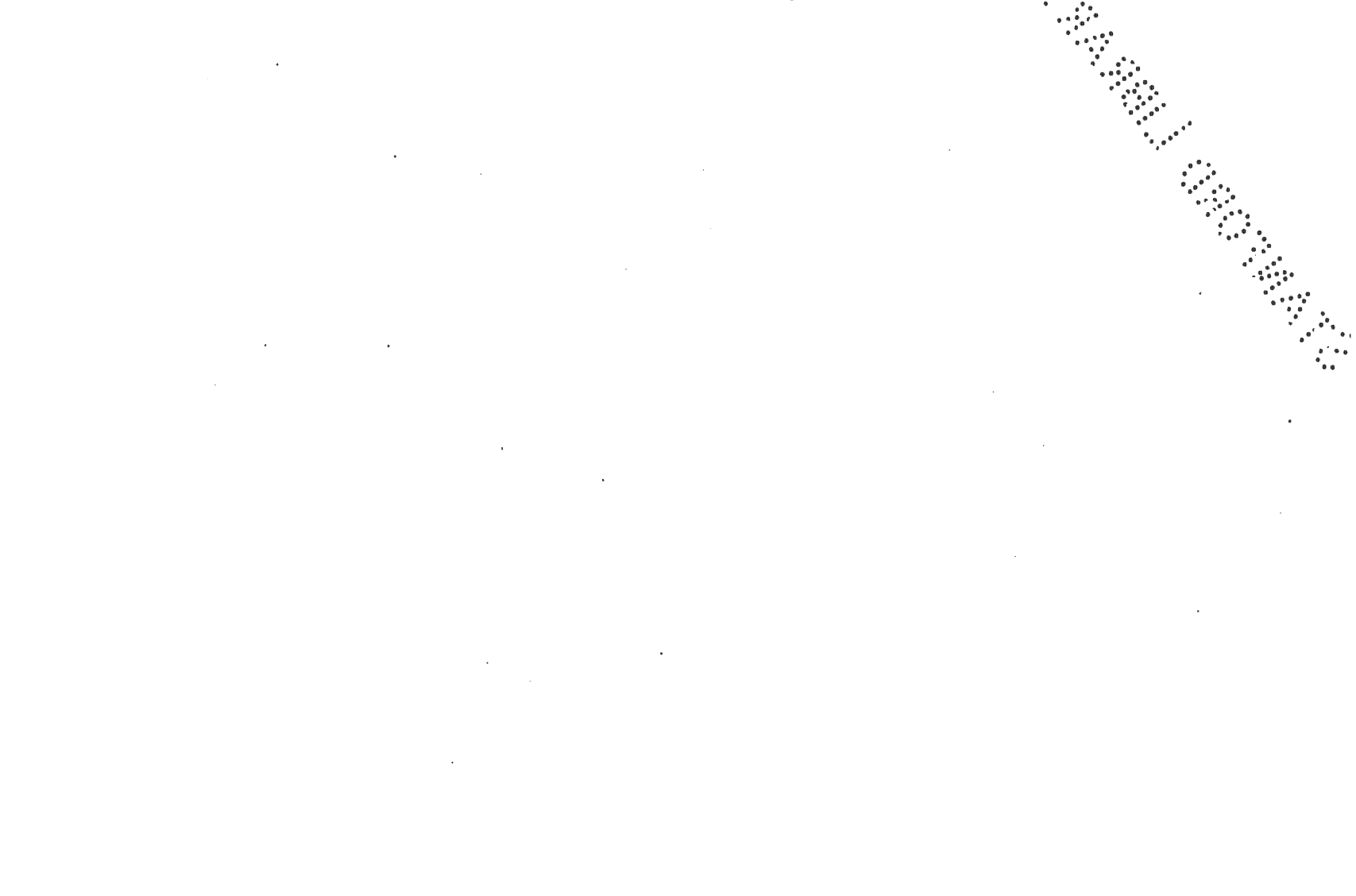
This sandstone crowns the top of the Kanawha series and was first named the **"Homewood"** sandstone by the Pennsylvania Survey. It has also been designated the Roaring Creek sandstone, from Roaring creek, a stream emptying into Tygart Valley river in Randolph county, W. Va., where it is finely exposed and occurs in great massive cliffs, current bedded and frequently pebbly, being grayish white.

This sandstone extends from Randolph county to the southern part of West Virginia, forming great massive cliffs wherever it is exposed. It makes cliffs along Elk river two miles above Sutton where it rises out of that stream, and forms massive cliffs along Elk from the mouth of O'Brien creek to Clendenin, where the ledge goes under the river until we come to Bream, seven miles above Charleston, where it begins to rise out of the water again, and forms the basal member of the "Charleston Sandstone" of Campbell at Charleston.

The Homewood sandstone comes above the bed of the Kanawha river near the mouth of Elk, and keeps on rising to the southeast until on the Warfield anticline at Marmet, 10 miles southeast of Charleston, it caps the hills 600 to 700 feet above the floor of the valley. At Montgomery on the southern edge of Kanawha county, this sandstone is 900 feet above the level of the railroad, and forms massive ledges 70 to 100 feet high.

The Homewood sandstone rises out of Davis creek just above the mouth of Middle Fork and climbing rapidly above the bed of the creek to the southeast, caps the hills of Davis creek and Coal river at an elevation of 1350 feet A.T., forming cliffs 60 to 75 feet high. This sandstone rises out of Coal river between the forks of Coal and Sproul, and forms cliffs 60 to 75 feet high, and rising rapidly to the southeast, soon ap-

PLATE XVII.—Homewood Sandstone at mouth of Kingshoal creek, Big Sandy District.



pears in the hillsides above the bed of Coal river, until at Peytona it caps the summits 700 to 800 feet above the river.

The Homewood sandstone appears above water level on the Kanawha river at the mouth of Elk Twomile, and is still further above drainage at the mouth of Baker Fork, cropping along the bed of the stream to Rutledge, where the base of the sandstone appears at 715′ A.T.L.

On Blue creek this sandstone rises above the bed of the creek at a point north of Billy Branch, about 4 miles from Blue Creek station, and rising above the stream forms great cliffs 50 to 100 feet in height to a point about one mile south of Blakeley, where it goes under Pearl Fork of Saint creek.

It rises out of Elk river just east of Clendenin, and forms massive cliffs on the north side of Elk river between Clendenin and Porter.

The top portion of this sandstone is quarried by Savage Brothers near the old Coal & Coke railroad depot in Charleston. This quarry will be discussed further in a succeeding chapter in this volume.

Underneath the Homewood sandstone, there usually occur shales, from 1 to 20 feet in thickness, mostly sandy and often containing bituminous slate and thin layers of coal, but the coal is impure and nowhere has it yet been found of workable thickness or commercial value.

The Kanawha Black Flint.

From 1 to 20 feet underneath the Homewood sandstone a very important stratigraphic marker occurs, which has long been known as the **Kanawha Black Flint.** In Volume II(A), page 487, Dr. I. C. White has the following to say in regard to this stratum:

"The older geologists, Rogers, Stevenson and others, regarded this stratum as the beginning of the Conemaugh or Barren series of measures, and in Vol. II the writer adopted the same view.

"The paleobotanic studies of David White, and the later stratigraphic work of Stevenson, Campbell and the writer have demonstrated that the older views were erroneous, and that the Kanawha Black Flint occupies a position either near the base of the Allegheny series according to Stevenson (Putnam Hill Limestone), or entirely below the Allegheny in the Mercer group, according to the latest conclusions of David White and the writer as well. Mr. David White was for-

merly inclined to correlate it with the **Vanport** or **Ferriferous Limestone** of the basal portion of the Allegheny, but his latest conclusions would place it below the **Homewood sandstone** in the **Mercer group** in entire agreement with the writer's present conclusions from stratigraphy.

"Dr. Jno. J. Stevenson, as stated above, would place it higher, however, at the horizon of the **Putnam Hill Limestone** (the lower division of the Vanport), so that there no longer remains much doubt that the stratum in question belongs to either near or just below the base of the Allegheny series."

That this stratum early attracted the attention of the geologists who visited the Kanawha Valley is attested by the following quotation from Prof. W. B. Rogers, in his description of this bed in his Fifth Annual Geological report to the State of Virginia in 1839, as follows:

"The landmark to which I here allude, and which was first recognized, and afterwards diligently traced by my brother, Prof. J. B. Rogers, consists of a band of black silicious rock, approaching the character of a flint or hornstone, which is found in the hills at the height of several hundred feet above the river near the falls (Kanawha) and which, accompanying the subjacent strata in their various undulations, and their ultimate steady western dip as they extend down the river, is seen to disappear below the water level at the Elk river shoals.

"This stratum from its striking peculiarity of character, and its constancy of geological position, furnishes a standard line with which to compare the rocks and coal seams both above and beneath, and may be regarded in this region as clearly defining the boundary between the upper and lower series. As will be seen hereafter, throughout the tract extending from the falls (Kanawha) to the point at which the flint comes down to the river level, no seams of coal, but such that are local and of insignificant extent, occur in the hills above this stratum, but as we proceed toward the west, and thus in virtue of the westerly dip of the rock pass successively into strata higher in the geological order, we meet with one or more coal seams (Pittsburgh) associated with the shaly rocks already noticed as predominating in the upper series."

And on a subsequent page he gives the followng:

"BLACK SILICIOUS ROCK, FLINT OR HORNSTONE."

"This remarkable deposit which here appears of the thickness of seven feet, and at an elevation in the hills above the road at Ryder's creek of 466 feet, may be traced by its debris from near the falls (Kanawha), and seen capping the hills in broken masses at the head waters of Scrabble creek. It is found up the northwest side, forming the tops of the hills, but cannot be traced in this direction above Twenty-Mile creek. Thence it proceeds with a general gentle dip to the northwest, and is found up all creeks flowing into Kanawha river. At Smither's, Ryder's and Hughes' creeks it occupies a considerable elevation in the hills, being overlaid by a coarse sandstone, which as

PLATE XVIII(a).—Scene on Paint Creek showing the Kanawha Series in southern part of Kanawha County.

PLATE XVIII(b).—Kanawha Black Flint in C. & O. railroad cut just east of the C. & O. depot, Charleston.

The **Coalburg coal** is mined on Paint Branch of Cabin creek by the Wyatt Coal Company, where the following section was measured, in Horton Mine No. 2:

Section of Coalburg Coal in Horton Mine No. 2. Wyatt Coal Company, Paint Branch.

		Feet.	Inches.
1	Slate.		
2	Impure coal .....2′-6″		
3	Cannel coal .....0′-4″		
4	**Coal, block** .....2′-2″		
5	Bone, (Nigger head).....1′-0″	 9	0
6	**Coal, block** .....1′-6″		
7	**Coal, gas** .....1′-6″		
8	Slate floor, 1060′ A. T. B.		

Nos. 2 and 3 are not taken out, but are left in the mine.

The following is a section of the **Coalburg coal** in the Wacomah mine, operated by the Paint Creek Collieries Company, at Wacomah on Paint creek:

Section of Coalburg Coal in Wacomah Mine, Wacomah, Cabin Creek District.

		Feet.	Inches.
	(Sandstone, massive.)		
	Slate, bituminous	1	0
	Coal .....1′-2″		
	Bone (Nigger head) .....0′-2″		
	Coal .....1′-0″		
	Bone (Nigger head) .....0′-4″	 7	11
	Coal, cannel .....1′-6″		
	Coal, block .....3′-9″		
	Fire clay floor. Elev. 1165′ A. T. B.		

The foregoing are a few of the sections showing the general structure of the **Coalburg coal.** In a succeeding chapter of this volume, several other sections of this coal will be given, showing the thickness, quality and occurrence of same, also a calculation of the approximate tonnage of coal of merchantable thickness in this bed in Kanawha county.

The Upper Winifrede Sandstone.

From 10 to 20 feet under the Coalburg coal and overlying the Winifrede coal, there occurs a massive grayish brown, micaceous sandstone that is usually fine grained. Dr. I. C.

PLATE XX.—Coalburg Sandstone at Acme, Cabin Creek District.

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PLATE XX.—Coalburg Sandstone at Acme, Cabin Creek District.

PLATE XIX(a).—Chimney Rock, Coalburg Sandstone on Kanawha river east of Coalburg.

PLATE XIX(b).—Scene east of Charleston showing the Kanawha Series capped with the Allegheny.

PLATE XIX(a).—Chimney Rock, Coalburg Sandstone on Kanawha river east of Coalburg.

PLATE XIX(b).—Scene east of Charleston showing the Kanawha Series capped with the Allegheny.

On the north side of the Kanawha river the **Stockton-Lewiston coal** is exposed at the north end of Morris street in the city of Charleston, at an elevation of 640′ A. T. B. and gradually rises above the floor of the valley until at the east end of the city, between Ruffner and Wilson branches, it is exposed just above the stone crushing plant on land of A. S. Alexander, where it has been mined by the Kanawha Stone Company, and the following section was measured:

Section of Alexander Rock Quarry, City of Charleston.

	Thickness Feet.	Total Feet.
Kanawha Black Flint	4	4
Sandy shale	4	8
Coal, Stockton-Lewiston	4	12
Slate	2	14
Sandstone, buff, medium coarse, Coalburg	50	64
Concealed to K. & M. Ry. Elev. 629′ A. T. B.	65	129

The coal rises rapidly above the bed of the Kanawha valley to the southeast, until at Malden it is 480 feet above the level of the K. & M. railroad grade, and at Belle, just east of the Warfield anticline its horizon comes 640 feet above the level of the K. & M. railroad. At Shrewsbury in the Coalburg syncline the Stockton-Lewiston coal comes about 550 feet above the level of the Kanawha and Michigan railroad.

On Cabin Creek the **Stockton-Lewiston coal** is mined by the Cabin Creek Consolidated Coal Company at Ohley, as given on a previous page, by the National Bituminous Coal & Coke Company at Eskdale, see Eskdale section, and by the Lamont Mining Company at Beth.

This seam appears in the hills at Dekota, Carbon and Highcoal, as shown in the section at those points.

The Stockton-Lewiston coal comes out of Blue creek, near the mouth of Billy Branch, and rises rapidly above the floor of the valley until at Quick, it is about 120 feet above creek level, where it was once mined by J. B. Workman, who reports it 4 feet thick.

On Spruce Fork of Middle Fork of Blue Creek, 1.6 miles northeast of Blakeley P. O., George Dillard has opened this seam, where the following section was measured:

be given to this coal bed, owing to the fact of its being mined at Belmont, where the coal produces an excellent quality of splint. There seems to be some objection to the retention of the name **"Stockton"** as it appears that this name was first applied to the Cannel portion of the bed only and thus if the name **"Stockton"** is ever discarded the name **"Belmont"** might be substituted. The bed in question is always a multiple one, and the writer has used the name **Stockton-Lewiston** for the seam, since he finds that in actual practice by the miners and coal fraternity the name **Lewiston** is more generally applied to this seam than any other.

The **Stockton-Lewiston bed** while persistent and nearly always present, in the Kanawha Series, is often split into several layers by shales and even when thick contains considerable dirty coal mixed with slate, bone and rock material, so as to be of little commercial value under present mining conditions. But the time will come in the future when the large quantity of good coal mixed up with so much impurities will be washed and cleaned by picking table methods (which are already being used in the New River and Pocahontas coal fields for the preparation of the coals), and then this coal will be marketed and produce a business, quite as profitable as that now attained with purer beds of coal. However, on Slaughters and Cabin creeks in Kanawha county this bed appears in a purer state and is now mined by several operating companies on the latter creek, as well as at Belmont and on Gauley river. It is an excellent splint, breaking into a hard lump coal that is eagerly sought after for general fuel and steam purposes.

This coal was formerly mined in a small way for fuel at the salt factories which formerly existed on the Kanawha river between Charleston and Lewiston, but since these furnaces have practically all been closed, the mining of the coal has practically ceased, except a few small country banks where the coal is still mined for local fuel use and hauled away from the mines in wagons.

The Stockton-Lewiston coal rises above the bed of the Kanawha river near the Chesapeake and Ohio railroad depot, and about one-half mile east of same, at the mouth of Porter Branch it appears in the railroad grade. A section of the coal at this locality is given on page 265 of this volume.

Stockton Shales.

The interval, 4 to 30 feet, between the Kanawha Black Flint and the roof of the Stockton-Lewiston coal, is made up of sandy shales and slates. These shales often contain plant fossils. A study of these plant fossils was made by Dr. David White, and a list was published in Vol. II, West Virginia Geological Survey, pages 326-327, 1903.

THE STOCKTON-LEWISTON (Belmont) COAL.

At from 4 to 50 feet under the Kanawha Black Flint, there occurs a great multiple bedded seam of coal of widely extended distribution. This seam is very persistent and is nearly always present wherever the Kanawha series has any considerable development. It was first called the **Stockton coal,** owing to the fact it was long ago mined by Mr. Aaron Stockton, in the hills north of Montgomery where the upper portion being Cannel, was used for making oil. There the coal occurs 15 feet under the Kanawha Black Flint, and is separated from it by sandy shale. The coal is there about 6 feet thick with some slate partings. The opening has long been abandoned, and the writer was unable to get an accurate section of the coal. This coal was also early mined at Lewiston, a village on the south side of the Kanawha river, 13 miles southeast of Charleston, and was there called the **"Lewiston."**

A section taken at the old mine is as follows:

Lewiston Section.

	Feet.
Sandstone, massive, coarse, Homewood	75
Kanawha Black Flint	5
Sandy shale and concealed	15
Coal opening, abandoned, Stockton-Lewiston, 1190' A. T. B.	5

This coal bed is also mined at Belmont, a small village on the C. & O. railroad, 20 miles southeast of Charleston, and is there known locally as the **Belmont** seam.

It has been proposed by Mr. Neil Robinson, mining engineer and coal expert of Charleston, that the name **'Belmont'**

At Porter Station, 3 miles northeast of Queen Shoals and 0.3 mile east of the Kanawha county line, this ledge appears in the railroad cut in the following section:

Porter Section.

		Feet.	Inches.
Shale with iron ore nodules		..	..
Kanawha Black Flint, 650' A. T. B		7	0
Slaty fire clay		1	8
Coal ..... 1'-1"			
Slate and fire clay.... 1'-2"	**Stockton-Lewiston**	3	7
Coal, visible ..... 1'-4"			

General Character.

The general structure of this stratum is quite variable, and it breaks into small square and oblong blocks, from 2 inches to 2 feet thick and from 6 inches to 4 feet long. These blocks are so hard that erosion has very little effect on them, even after being carried by streams many miles they have no apparent polish. The blocks break off from the stratum, roll down the steep hills and are scattered along the beds of the streams, and thus it is not difficult to find traces of this ledge in the streams if it occurs in the hills above.

A sample of the Kanawha Black Flint was collected from a ledge in a field of Joseph Conner's on Davis creek, Loudon district, 3 miles southeast of Chilton, the composition of which is reported by Prof. Hite as follows:

Analysis of Kanawha Black Flint.

	Percent.
Silica ($Si\ 0_2$)	83.09
Ferric Iron ($Fe_2\ 0_3$)	4.40
Alumina ($Al_2\ 0_3$)	6.94
Lime (Ca0)	0.53
Magnesia (Mg 0)	0.76
Sodium (Na_20)	0.54
Potassium ($K_2\ 0$)	1.44
Titanium ($Ti0_3$)	0.33
Phosphoric Acid	0.36
Moisture	0.31
Loss on ignition	2.10
Total	100.80

of Spangler Fork of Middle Fork of Blue creek it crops at 1109' A.T.L., and 23 feet above the Stockton-Lewiston coal.

On Laurel Fork of Blue creek about 0.8 mile from its mouth, the ledge goes under the water, where the following section was measured:

Laurel Fork Section.

	Feet.	Inches.
Sandstone, massive, Homewood	40	0
Shale	4	0
Kanawha Black Flint { blue black..4' / gray .....3' }	7	0
Fire clay	1	9
Coal, hard, glossy	0	2
Fire clay	2	8
Sandstone, sandy shale and concealed to creek bed	3	0

The Kanawha Black Flint appears in the hill to northwest of House Branch of Bells creek, and 0.3 mile west of the Nicholas-Fayette county line 0.7 mile east of the Kanawha-Fayette county line, where the following section was measured:

(Sandy shale.)

Kanawha Black Flint, 1255' A. T. B.	5'-0"
Slate	4'-0"
Coal	0'-8"
Slate	0'-1"
Coal	1'-0"
Bone	0'-3"
Coal, visible	0'-7"

Stockton-Lewiston.

This coal has been opened by T. B. Craze and mined for fuel use.

One mile up Hughes Fork of Bells creek, just northwest of the Fayette-Kanawha county line, at the forks of the stream, the Flint crops in a 4 foot ledge at 1180' A.T.B.

Passing on up the left hand branch of Hughes Fork one mile farther to the southeast along the Fayette-Kanawha county line the Black Flint appears in a 2 foot ledge at 1220' A.T.B.

The Flint appears in railroad grade at Queen Shoals station on the Coal & Coke railroad from 4 to 6 feet thick, at an elevation of 643 feet A.T.L. and 196 feet under the No. 5 Block coal.

The **Kanawha Black Flint** crops at Hugheston, near the mouth of Hughes creek at an elevation of 1330 feet and 80 feet above the **Coalburg coal** mined by the Hugheston Coal & Coke Company at that point, and on Sugar Camp Branch of Hughes creek, the ledge appears at an elevation of 1285 feet A.T.B., and 85 feet below the **Coalburg coal.** On Shadrick Fork of Hughes creek the Flint crops at an elevation of 1230 feet, where it goes under water level, and about one mile east of this point on Main Hughes creek, the following section was measured, showing the occurrence of the Flint ledge:

		Feet.	Inches.
Kanawha Black Flint, dark, 1200′ A. T. B.		8	0
Sandy shale		20	0
Coal ..... 0′-4″			
Slate ..... 1′-0″	**Stockton-Lewiston.**	3	4
Coal, visible ..... 2′-0″			

On Slater Branch, one mile west of Cannelton, the ledge crops out 6 feet thick at an elevation of 1195 feet A.T.B. and just under a massive sandstone (Homewood) 80 feet thick. On Buffalo Fork of Smithers creek, just west of the school house, 3.5 miles northeast of Cannelton, the Flint crops at an elevation of 1250 feet A.T.B. and 140 feet under the No. 5 Block coal opened by the Cannelton Coal & Coke Company.

This Flint comes to the surface on Blue creek just below the mouth of Billy Branch at about 635′ A.T.B. and rises rapidly southward up Blue creek.

At mouth of Billy Branch the Flint shows up in the county road in an 8 foot ledge at an elevation of 655′ A.T.L., just 100 feet below the No. 5 Block coal, while on further up Blue creek almost due south about 0.6 mile the Flint crops in a 5 foot ledge at an elevation of 735′ A.T.B., showing a rise of 80 feet in 0.6 mile. On going south 50° east 1.4 miles further up Blue creek to mouth of Laurel Fork, the Black Flint has risen from 735′ A.T.B. to 810′ A.T.B. showing a rise of 75 feet in this distance or about 50 feet to the mile, and at Quick 1.2 miles due south its elevation is 835 feet A.T.B. or only a rise of 25 feet in that distance. The Coalburg coal was once mined here, 90 feet under the ledge.

The Flint appears in the hills at mouth of Middle Fork of Blue creek at an elevation of 1085 feet A.T.B., and on the head

dipped from 1220′ A.T.B. at mouth to 1140′ A.T.B. at head or 80 feet in a distance of 7 miles, about 11 feet per mile.

On Frozen Branch of Kelly creek, 1.5 miles northeast of Cedar Grove and at 120 feet above the Coalburg coal the Black Flint crops in a 5 foot ledge at an elevation of 1220′ A.T.B.

At a point 0.7 mile up Sugar Creek Branch of Kelly creek, on east side of hill, the **Kanawha Black Flint** crops in a 3 foot ledge at an elevation of 1125′ A.T.B. This point is 1.3 miles northwest of its crop on Frozen Branch and shows a dip of 85 feet or at the rate of 65 feet per mile.

One mile up Bufflick Branch of Kelly creek the Flint crops in a 4 foot ledge with sandy shale above and below, at 1145′ A.T.B., while a mile above, it crops in a 5-foot ledge at an elevation of 1250′ A.T.B. At a point just south of Ward P. O. on same creek this ledge crops in the hill as shown in the following section:

	Feet.	Inches.
Concealed	15	0
Kanawha Black Flint, 1145′ A. T. B.	5	0
Sandstone and concealed	115	0
Coal, Coalburg	5	0

1.3 miles up Big hollow, due north of Wood P. O. on Kelly creek the Kanawha Black Flint crops in a 4 foot ledge at an elevation of 1140′ A.T.B., while near Mammoth P. O., 1.3 miles above, the Flint appears as shown in the following section:

	Feet.	Inches.
Sandstone, massive	30	0
Sandy shale and concealed	5	0
Kanawha Black Flint, 1145′ A. T. B.	7	0
Sandy shale and concealed	48	0

One mile up Goose hollow of Kelly creek, and 2 miles northeast of Mammoth P. O. the Flint appears as shown in the following section:

Section 2 Miles Northeast of Mammoth P. O.

(Sandstone.)	Feet.	Inches.
Coal, No. 5 Block	5	0
Sandstone and concealed	154	0
Kanawha Black Flint, 1115′ A. T. B.	6	0
Sandstone and concealed	75	0
Coal, Coalburg	5	0

Belle Section.

	Feet.	Inches.
Sandstone, cliff rock	75	0
Sandy shale and concealed	15	0
Kanawha Black Flint, 1285′ A. T. B.	4	0
Sandstone, cliff rock	100	0

Near the mouth of Witchers creek, about half way between the Belle and Diamond sections the Flint appears between two massive sandstones in a 3 foot ledge at an elevation of 1220′ A.T.B.

Passing northeast up Witchers creek about 2 miles from the Kanawha river, the Kanawha Black Flint crops on the south side of Witchers creek in a 2 foot ledge at an elevation of 1200′ A.T.B.

In Watson Branch of the Kanawha river, one mile due north of Shrewsbury station on the K. & M. R. R., the **Flint** crops in a 4 foot ledge, 140 feet below the **No. 5 Block coal** mined by the Sunday Creek Coal Co., and 110 feet above the **Coalburg coal** which has been opened at an elevation of 1135 feet A.T.B.

On a branch of the Left Fork of Witchers creek, in Hunt hollow just east of the Elk-Cabin creek district line in Cabin Creek district, the Flint appears in a 4 foot ledge at an elevation of 1225′ A.T.B. On up Hunt hollow, one mile northeast, the Flint is found at 1200′ A.T.B., and at the mouth of Hunt hollow it occurs in a 6-foot ledge at an elevation of 1200′ A.T.B.

On the Left Fork of Witchers creek the Black Flint appears in the hill to the east of the creek at an elevation of 1113′ A.T.B. and 65 feet above some abandoned coal openings which are possibly on the Coalburg seam.

In the head of Steepgut hollow of Witchers creek the Black Flint crops in a 3 foot ledge at an elevation of 1135′ A.T.B., while in the extreme head of Witchers creek near the Cabin Creek-Elk district line it crops in a 5 foot ledge at an elevation of 1140′ A.T.B. It was also noted on Dry Branch at an elevation of 1220′ A.T.B.

Passing up Witchers creek north 62° east, 7 miles from mouth to source, we find that the Kanawha Black Flint has

on head of Right Fork of Coal Fork of Campbell creek, in a 5 foot ledge at an elevation of 1100′ A.T.B.

On the main fork of Coal Fork of Campbell creek, about one mile southeast of Coal Fork P. O. and 365 feet above the Peerless coal the Flint crops in a four foot ledge at 1105′ A.T.B., and also on a small branch of Campbell creek, one mile west of the mouth of Twomile Fork of this creek, the Black Flint crops 5 feet thick, and 60 feet above the Coalburg coal.

Near the head of Twomile Fork, 1.4 miles northeast of its mouth, this ledge goes under the creek, at an elevation of 935 feet A.T.B. and 600 feet beneath the No. 5 Block coal.

In the high point just north of the mouth of Simmons creek of Kanawha river the Kanawha Black Flint appears as follows:

	Feet.	Inches.
Sandy shale	7	0
Kanawha Black Flint, 1315′ A. T. B.	3	0
Sandstone, massive	70	0

In a high point about half way between Marmet and Winifrede Junction on the southwest side of the Kanawha river the Kanawha Black Flint crops in a 4 foot ledge at an elevation of 1270′ A.T.B., the No. 2 Gas coal being opened 505 feet directly below.

At the head of Kelly Branch of Simmons creek, the Kanawha Black Flint crops in a 5 foot ledge at an elevation of 1320′ A.T.B. This is near the crest of the anticline passing south of Malden. This point is 8 miles south 42° east from the C. & O. station at Charleston and shows a rise of 720 feet in 8 miles or 90 feet per mile.

At a high point east of Diamond station of the K. & M. R. R. the Kanawha Black Flint appears as shown in the following section:

Diamond Section.

	Feet.	Inches.
Sandstone, massive	55	0
Kanawha Black Flint, 1195′ A. T. B.	3	0
Sandy shale	10	0
Coal blossom (Stockton-Lewiston)	2	0
Sandstone, massive, cliff rock	100	0

0.3 mile due east of Belle station on the K. & M. R. R., the Black Flint appears as shown in the following section:

		Feet.	Inches.
(Sandstone, massive.)			
Kanawha Black Flint		6	0
Slate and sandy shale		3	0
Slate		0	3
Coal, splint ..... 1'-0"			
Slate ..... 0'-4"			
Coal ..... 1'-1"	Stockton-Lewiston	4	1
Bone ..... 0'-3"			
Coal ..... 0'-8"			
(Slate floor.)			

Elevation of Kanawha Black Flint 640' A. T. B.

Passing on up Elk Twomile to Rutledge P. O. or the mouth of Valley Grove Branch, the Kanawha Black Flint is 4 feet thick as shown in the following section:

	Feet.	Inches.
(Sandstone, massive cliff rock.)		
Kanawha Black Flint	4	0
Slate, bituminous	5	0
Coal, Stockton-Lewiston, concealed	0	9

Elevation of Kanawha Black Flint 712' A. T. L.

This shows a dip of 72 feet in one mile due west from Rutledge. On Valley Grove Branch, 0.7 mile almost due south from Rutledge P. O. the **Kanawha Black Flint** crops in a 3-foot ledge at an elevation of 785' A.T.B. This shows a rise of 73 feet in 0.7 mile or about 104 feet per mile. One foot of Stockton-Lewiston coal appears at 12 feet below the flint at this point.

1.5 miles due north of Dana, in county road leading from Dry Branch to Valley Grove Branch, 3 feet of the Kanawha Black Flint crops as follows:

Sandstone, massive, Homewood	80'
Kanawha Black Flint, 940' A. T. B.	3
Sandstone, massive	42
Coal blossom, Coalburg	4

Near the head of Dry Branch of Campbell creek, the **Kanawha Black Flint** crops in a 4 foot ledge at 950' A.T.B., and is also seen at the same elevation on the divide between the head of Dry Branch and the head of Younger Branch where it is 30 feet above the **Stockton-Lewiston** coal.

On south side of Campbell creek, almost opposite the mouth of Clover hollow, the Kanawha Black Flint crops in a 4 foot ledge at an elevation of 1030' A.T.B., and it also appears

Hill. Here it is about 4 feet thick and is a gray, silicious stratum, and does not appear to be as hard as on the north side of the Kanawha river. It rises quite rapidly to the head of Davis creek, and appears in a low gap on the dividing ridge between Davis and Lens creeks at an elevation of 1310 feet. Here it has assumed a ferruginous nature and was once mined for iron ore, and called the "Black Band Iron Ore." The stratum appears not to hold its flinty nature constantly to the south of the Kanawha river, and when found on Coal river, is usually a soft gray slate containing silicious material.

The **Kanawha Black Flint** was found on Cabin creek as far south as Ohley, where it occurs about 10 feet above the Stockton-Lewiston coal, mined by the Cabin Creek Consolidated Coal and Coke Company, and does not show its usual hardness.

On Paint Branch of Cabin creek this ledge appears about 5 feet thick and is hard.

On Paint creek the writer found the Kanawha Black Flint as far south as Wacomah, where it occurs in a ledge 4 feet thick at an elevation of 1275 feet A. T.; also on Morris creek 1 mile south of Donwood P. O., where it is 5 feet thick and occurs at an elevation of 1515 feet A.T.B.

Teets found this stratum on Armstrong creek, just east of Powellton on top of the hill at an elevation of 2045 feet A.T. or more than 1,000 feet above the bed of the valley.

The Kanawha Black Flint occurs north of the Kanawha river, on the different tributaries of Kanawha and Elk as far north as the eastern boundary line.

The best development of this ledge occurs on Campbells creek, where the stratum attains a thickness of 8 feet, and is very hard, being almost black in the ledge, but particles breaking off, weather all different shades from black to blue and cream color. The Indians made arrow and spear heads from the ledges on this creek. It goes under Campbells creek near Putney at an elevation of 1105′ A.T.L.

The **Kanawha Black Flint** appears on Elk Twomile creek at 1.5 mile due east from Twomile station of the Coal & Coke railroad, on land of Robert Clay as follows:

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PLATE XXI(a).—Winifrede Sandstone on Kanawha river east of Pratt.

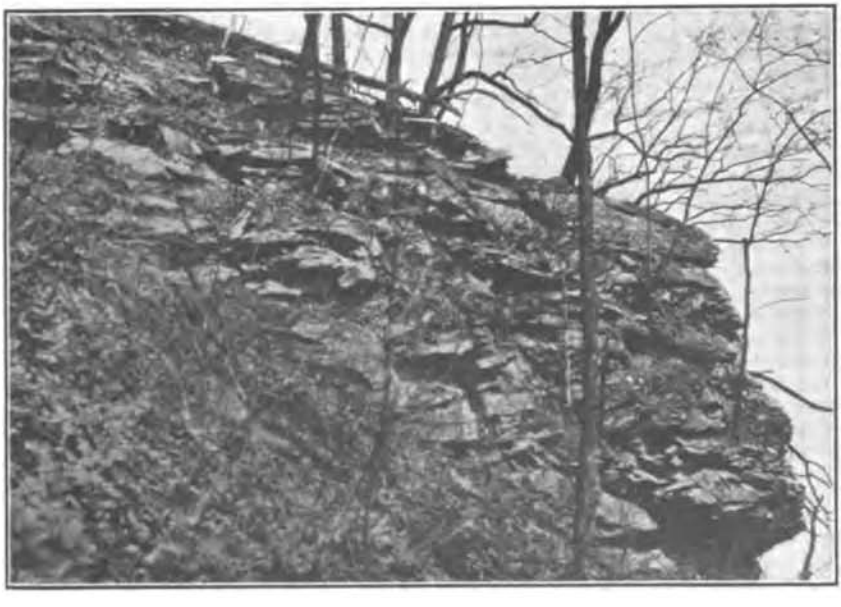

PLATE XXI(b).—Winifrede Sandstone on Paint Creek near Paint Creek Junction.

	Thickness Ft.	In.	—Total— Ft.	In.
Slate	2	0	6	10
Sandstone and concealed	43	0	49	10
Coal blossom, Chilton	2	2	52	0
Sandstone and concealed	20	0	72	0
Limestone, impure, fossiliferous	1	0	73	0

The Winifrede coal was once mined on Donley Branch of the Kanawha river near Kanawha City, for fuel coal and used in the salt furnaces more than 50 years ago. Here the coal comes 170 feet under the **Kanawha Black Flint.**

The following section shows the occurrence of the coal at an opening where the coal is now being mined for local fuel by Nathan Gay and transported in wagons from the mine on Donley Branch, one-half mile south of Kanawha City:

Section Winifrede Coal, Nathan Gay Coal Opening, Loudon District.

(Sandstone, massive, Winifrede.)		Feet.	Inches.
Coal, splint 1'-0"			
Impure coal and slate 1'-3"	....	3	11
Coal, block 1'-8"			
Elev. 975' A. T. B.			

The Winifrede coal has been mined on Davis creek, at Chilton, 8 miles south of Charleston by the Black Band Coal & Coke Company, and was there locally named the **Black Band Coal.** These mines were suspended about four years ago, and have never resumed operations. The coal comes from 150 to 175 feet under the Kanawha Black Flint, and is a hard block coal.

The following is a section of the coal measured at the mouth of Shrewsbury hollow of Davis creek, 1.5 miles northeast of Chilton.

Section of Winifrede Coal, Loudon District.

(Sandstone, massive.)		Feet.	Inches.
Coal, splint 1'-5"			
Coal, block 1'-2"	....	2	7
Slate floor. Elev. 910' A. T. B.			

The Winifrede coal rises above the K. & M. Railway grade at the eastern end of the corporation limits of the city of Charleston, just west of Wilson Branch, where the coal has been mined, and occurs 147 feet under the Kanawha Black Flint.

There appears to be some question on Cabin creek and Coal river, from Seng creek to Colcord, in regard to the correlation of the Winifrede and Coalburg coals. It is evident from the sections already given that the Kanawha series thicken rapidly from Charleston to the southeast, and in order to show relative relations of the different coals, the writer has compiled from the sections already given, a table giving the intervals between the different coals in the Kanawha series, their relative position to each other and the **Kanawha Black Flint.** Where the **Kanawha Flint** is absent the base of the **Stockton-Lewiston coal** is used for the stratum as this coal usually occurs from 5 to 35 feet under that stratum.

From the foregoing table it will be noted that the intervals between the **Stockton-Lewiston coal** and **Winifrede coal** and the **Winifrede coal** and the **No. 2 Gas coal** are as follows:

Interval between Winifrede-Stockton and Winifrede—No. 2 Gas.

SECTIONS—	Stockton-Lewiston. Feet.	No. 2 Gas. Feet.
Charleston	139	...
Olcott	106	...
Marmet	120	375
Hernshaw	137	369
Winifrede	170	385
Lewiston	136	428
Ronda	205	(350)
Ohley	205	390
Eskdale	176	392
Lamont	190	443
Acme	248	485
Kayford	295	430
Wevaco	227	472
Decota	289	424
Carbon	125(?)	517(?)
Nabob	173	499
Highcoal	259	434
Dorothy	200	580
Donwood	(246)	410
Sand City	180	343
Hickory Camp	...	527
Tomsburg	153	509
Montgomery	155	397
Crescent	242	355
Handley	110	398
Red Warrior	165	510

It will be observed that the interval between the **Winifrede** and **Stockton-Lewiston coals,** varies from 106 feet at Olcott, to 295 feet at Kayford, and the interval between the **Winifrede** and the **No. 2 Gas coals,** varies from 342 at Sand City to 580 feet at Dorothy, compared with 424 feet at Decota, and 485 feet at Acme. It will be further observed from these figures that these intervals vary at different points, but with a general increase in thickness to the southeast.

Other sections illustrating the thickness and structure of the coal will be given in a subsequent chapter.

PLATE XXII.—Winifrede Sandstone, overlooking the Kanawha river east of Coalburg.

NAVAL WAR COLLEGE

The Lower Winifrede Sandstone.

At 1 to 5 feet under the Winifrede coal there often occurs a massive sandstone that has been designated by Dr. I. C. White the **Lower Winifrede sandstone,** from its position under the coal of that name. This stratum is often gray and massive and seldom very micaceous. It frequently splits up into shaly sandstone, or sandy shale, and sometimes contains a small bed of coal, apparently an offshoot from the Winifrede coal. The stratum is from 30 to 60 feet in thickness.

The Chilton Sandstone.

This Lower Winifrede sandstone is sometimes divided and then the lower portion of the bed is called the **Chilton sandstone** by Dr. I. C. White. This stratum is fine grained, micaceous, being dull gray, or dove colored, and often contains limy layers. It is from 10 to 30 feet in thickness.

The Chilton Coal.

At 40 to 75 feet under the **Winifrede coal** a fairly persistent bed of impure coal appears, that Dr. I. C. White has designated the **Chilton coal,** from Chilton, a small mining village in Kanawha county, 8 miles south of Charleston, near which this coal forms a conspicuous crop along the banks of Davis creek.

The coal exhibits the following structure and stratigraphic relations near Chilton:

Section of Chilton Coal, Loudon District.

		—Thickness— Ft.	In.
Coal, Winifrede, Black Band		..	..
Massive sandstone and concealed		70	0
Coal, hard ..... 0'-5"			
Fire clay ..... 2'-0"	Chilton	3	5
Impure coal ..... 1'-0"			

At Hernshaw on Lens creek, 4.5 miles southeast of Chilton, the following is a section of this coal opened by the Marmet Coal Company:

Section of Chilton Coal, Hernshaw, Loudon District.

		—Thickness— Ft.	In.
Coal, Winifrede, Black Band.			
Sandstone and concealed		94	2
Coal .....1'-0"			
Slate and fire clay .....4'-0"	**Chilton**	5	5
Coal .....0'-5"			

So far as known this bed is of little or no commercial value, being generally slaty and sulphurous. However, it is possible that to the southeast in the Coal river region the bed may reach a thickness that will prove of commercial value.

Underlying the **Chilton coal** there often occurs a massive dull gray dove-colored micaceous sandstone from 20 to 70 feet thick that has not yet received a distinctive name. This sandstone is massive, but often flaggy and usually makes steep bluffs in the topography, sometimes making a part of the Malden sandstone below.

The Thacker Coal.*

The next lower coal bed of commercial value has been designated the **Thacker coal,** from a mining village of that name in Mingo county, where this coal has been mined on a large scale, and where it is a multiple-bedded seam, consisting of both splint and gas coals, frequently separated into several beds by layers of shale and slate or fire clay.

In Kanawha county the coal which appears to occupy the horizon of the **Thacker bed** of Mingo county is a hard, block seam, and makes an excellent splint fuel varying in thickness from 2 ft. 6 in. to 3 ft. 6 in. It is mined by the Marmet Coal Company on Lens creek, one mile south of Hernshaw, where the following section was taken:

		—Thickness— Ft.	In.
Coal (Winifrede and Black Band)			
Sandstone and concealed		94	2
Coal .....1'-0"			
Slate and fire clay .....4'-0"	**Chilton**	5	5
Coal .....0'-5"			
Sandstone and concealed		22	7
Coal, hard block, Thacker		2	10
Slate floor.			

*Dr. White regards the Thacker coal of Mingo County as coming at the horizon of the Cedar Grove bed.

This coal usually occurs from 100 to 120 feet over the Cedar Grove coal, and from 100 to 150 feet under the Winifrede bed. It is locally called the "Block" seam, where it is mined on Lens creek.

Malden Sandstone.

Between the Thacker coal, and the next underlying coal bed of commercial thickness, there occurs a grayish, dove-colored, micaceous and often flaggy sandstone which, together with the Thacker, has been designated the **Malden sandstone** by Dr. I. C. White. In Volume II(A), page 425, West Virginia Geological Survey, 1908, he gives the following description of these beds:

"Above the horizon of the last described coal bed there generally occurs in all of the regions covered by a good development of the Kanawha series, a very steep escarpment in the topography for 100 to 200 feet made by the crop of a hard, bluish-gray, flaggy, micaceous sandstone, sometimes becoming massive for a few feet, and often containing layers of calcareo-silicious rock material which are polished smooth along smaller gullies and brooklets by the erosive agencies of the streams. This steep escarpment is often continuous from the horizon of **No. 2 Gas coal**, 100 feet below the **Cedar Grove** bed, and it usually presents such a conspicuous feature in the topography, that it greatly aids the geologist in determining the proper horizon to prospect for these Kanawha coals when outcropping measures are covered up by vegetation and the soil rubbish of rock decay. To these hard rocks the name **Malden sandstone** has been given by the writer since they form a conspicuous landmark in the topography on both banks of the Great Kanawha River in the vicinity of Malden, Kanawha county, five miles above Charleston."

This sandstone has been quarried in the construction of Lock No. 4 in the Kanawha river just south of Dickinson, where the following section was measured:

		—Thickness— Ft.	In.
Sandstone, massive .....30' Sandy shales and concealed...20' Sandstone ..... 5' Sandy shale (gray) ..... 5'	.....	60	0
Coal, impure ..... 6" Slate ..... 4" Coal .....2'-2"	Cedar Grove..	3	0

At Riverside the Malden sandstone has been quarried for constructing Lock No. 3 on the Kanawha river. The following section was exposed here:

	—Thickness— Ft.	In.
Sandy shale and concealed.....40'		
Sandstone, massive, micaceous, fine grained .....20' }	60	0
Slate.		
Coal, Cedar Grove	3	0

The Cedar Grove Coal.

At 5 to 10 feet under the Malden sandstone and from 250 to 300 feet under the **Winifrede coal** there occurs another rather persistent bed that has been designated the **Cedar Grove coal.** It was first mined on a commercial scale at Cedar Grove, near the mouth of Kelly creek, from which village it takes its name.

The seam ranges in thickness from 2 to 3½ feet, and is a coal of most excellent quality, very low in sulphur, phosphorus, and ash, and an excellent fuel and domestic coal. It was first mined and shipped to southern markets by river in flat boats as early as 1844.

The bed is very persistent in the southern part of Kanawha county, and is mined along the Chesapeake and Ohio and the Kanawha and Michigan railways. The general structure of the coal is as follows, as measured in an opening of the Marmet Coal Company at Monarch:

	—Thickness— Ft.	In.
(Sandstone.)		
Coal	0	3
Slate	...	2 to 8
Coal, hard	1	4
Coal, very hard block	1	10
Slate floor.		

The coal is tough, fibrous, and does not disintegrate when exposed to the elements, consequently making an excellent coal for shipping to markets where a large percentage of lump is required.

The Peerless Sandstone.

At 5 to 10 feet under the Cedar Grove coal occurs a sandy shale and often a sandstone from 80 to 150 feet thick that has been designated the **Peerless sandstone.** The lower shales frequently hold a silicious limestone (Campbells Creek) from one to two feet thick.

This sandstone is bluish gray and fine grained, and frequently micaceous. It has been quarried at several places and makes an excellent building stone.

The Campbells Creek Limestone.

At an interval from 60 to 100 feet under the Cedar Grove coal, there is frequently found an impure, bluish gray limestone that Dr. I. C. White has designated the Campbells Creek limestone from its occurrence at the mouth of Campbells creek in Kanawha county, where it was first studied. This limestone often consists of lens-like concretions, and sometimes exhibits the "cone-in-cone" structure.

No marine fossils were observed in this stratum in Kanawha county.

The Peerless Coal.

This coal is possibly a split of the next bed below (the No. 2 Gas seam), but it is nearly always present and ranges in thickness from 1 to 3 feet. It took its name from a small mining village of that name (now abandoned) located on the south side of the Kanawha river, just east of Lewiston, where the coal was first mined on a commercial scale.

The following section shows the structure of the bed where it first derived its name:

Section of the Peerless Coal.

	—Thickness— Ft.	In.
Sandstone, massive, Peerless	25	0
Slate	2	0
Coal, gas	2	4
Slate floor.		

This coal was once mined by the Peerless Coal Company at Lewiston (now abandoned).

The following shows a general section of the coal:

Section of Peerless Coal in Mine of Peerless Coal Company.

Slate.		
Coal, gas	2′	8″
Slate floor.		

The seam is a beautiful single bedded coal, black, glossy and having a columnar structure. It is very rich in volatile matter, low in sulphur, and makes an excellent gas coal.

The Lower Peerless Sandstone.

Underlying the Peerless coal, and separating same from the next coal bed, is a series of sandy shales and sandstones, ranging in thickness from 5 to 80 feet, which the writer has designated **the Lower Peerless Sandstone.** This sandstone is bluish gray, of rather fine grain and micaceous. It quarries readily into small blocks and makes a very good building stone. It was used in the construction of the coke oven foundations at Eskdale by the Leewood Colliery Company (now the National Bituminous Coal & Coke Company), where it is from 25 to 30 feet thick, and underlies the Peerless coal as shown in the following section:

Eskdale Section, Cabin Creek District.

	—Thickness— Ft.	In.
Coal, gas, Peerless	2	0
Shale, bluish	10	0
Sandstone. massive, bluish gray, Lower Peerless	25	0
Sandy shale full of iron ore nodules	27	0
Coal, No. 2 Gas, 818′ A. T. L.	4	6

The sandy shales underlying this sandstone are usually dove colored and contain small nodules of iron ore, while the lower portion being slaty, makes an excellent roof for the underlying coal.

The No. 2 Gas Coal.

The next coal coming 5 to 80 feet under the Peerless bed. and 460 to 750 feet under the **Kanawha Black Flint,** is one of

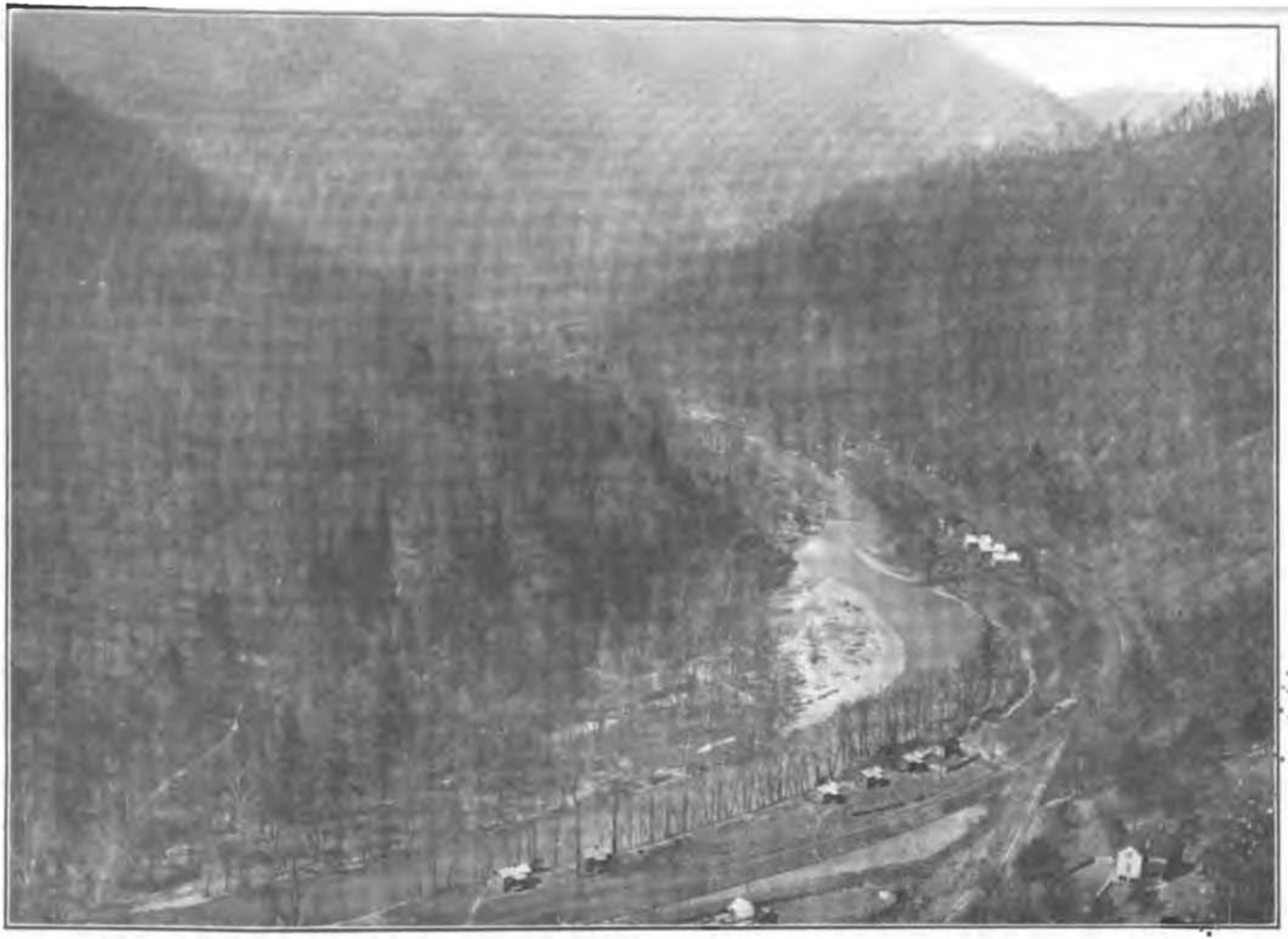

PLATE XXIII.—Mucklow looking north, showing the Kanawha Series on Paint Creek, Cabin Creek District.

HANSEL CATALOGUE

the most widely persistent and valuable beds of the entire Kanawha Series.

This coal has been designated variously as the **Campbells Creek Coal,** the **Ansted Coal** and the **Page Coal,** along the C. & O. Ry., in the Kanawha Coal field, and the **Warfield bed** on **Tug river** along the Norfolk & Western Ry., but it has become so widely known by the name of **"No. 2 Gas",** or simply **No. 2 coal,** that it would be useless to attempt to change its name to any local geographical designation, with the hope of having it adopted, as it would surely meet with failure.

This bed probably furnishes a greater tonnage than any other bed of the Kanawha series. It rises above the Kanawha river at Dana, 5 miles southeast of Charleston and extends in commercial thickness for more than 30 miles to the southeast along the Kanawha and Gauley rivers to Ansted, where it is mined by the Gauley Mountain Coal Company. The bed extends to the south into Boone, Raleigh, Mingo and Wyoming counties, until it finally disappears from the hill tops in western Raleigh and Wyoming counties. The bed changes its structure and character somewhat to the south, when it first comes above the bed of the Kanawha, Coal and Guyan rivers, in the western part of the coal fields, where it is a hard block or splint coal, and contains very few soft layers, but 10 to 15 miles farther east, it contains more soft and friable layers and yields an excellent coke, and is also a good by-product coal, being valuable for gas-making purposes. It is usually low in sulphur and ash and is a splendid steam and fuel coal.

The general structure of this coal where it was first mined on Campbells creek is as follows:

Section of No. 2 Gas Coal, Dana, Malden District.

	—Thickness—			
Slate roof—	Ft.	In.		
Coal, splint	1	10		
Slate	0	1		
Coal, hard	1	0		
Slate	0	1	5'	7"
Coal	0	10		
Fire clay	0	6		
Coal, hard	1	3		

The Marmet Coal Company mined this seam of coal on Lens creek, near Hernshaw, where the coal exhibits the foling character:

Sandstone—	—Thickness— Ft.	In.		
Coal	...	½ to 2		
Slate	...	2 to 12		
Coal, hard, splint	3	4	6′	6″
Slate	...	2 to 12		
Coal, gas	2	0		
Slate floor				

On Cabin Creek where this coal is extensively mined the following represents a section measured in the Kayford mine operated by the Cabin Creek Consolidated Coal & Coke Company:

Section of No. 2 Gas Coal, Kayford Mine, Cabin Creek District.

Slate roof—	—Thickness— Ft.	In.		
Coal, soft, columnar	3	5		
Coal, splint	1	0	5′	8″
Coal, soft, gas	1	3		

Another measurement showing the **No. 2 Gas coal** on Cabin creek was taken in Mine No. 1 of the West Virginia Colliery Company at Wevaco as follows:

Section No. 2 Gas Coal, West Virginia Colliery Company Mine No. 1.

Slate roof—	—Thickness— Ft.	In.		
Coal, medium hard	2	3		
Slate	0	4	5′	11″
Coal, soft, gas	3	4		

On Paint creek the Lackawana Coal and Lumber Company is mining the **No. 2 Gas coal** at Nucholls mine. The following section exhibits the structure of the coal at that point:

Section of No. 2 Gas Coal, Nucholls Mine.

	—Thickness—			
Sandstone—	Ft.	In.		
Coal, soft, columnar	2	9		
Slate, dark	0	5		
Coal, soft	1	1	4'	10"
Slate, dark	0	2		
Coal, soft	0	5		
Slate floor.				

The above section shows the coal has changed from a hard splint to a soft gas coal.

Other sections and locations of openings and mines in this seam will be given in a subsequent chapter.

The Brownstown Sandstone.

At 2 to 10 feet underneath the No. 2 Gas coal there occurs a dull gray sandstone, from 20 to 50 feet thick, that has been designated by Dr. I. C. White the **Brownstown Sandstone** from its exposure at Brownstown (now Marmet), a small village 10 miles southeast of Charleston.

The following section taken at Lock No. 2 on the south side of the Kanawha river at Montgomery exhibits its occurrence:

Section at Lock No. 2, Cabin Creek District.

	Thickness Feet.
Coal, No. 2 Gas	5
Slate	4
Sandstone, Brownstown, massive, brownish gray	22
Coal, Powellton	2

Another section measured at mouth of Simmons creek near Belle is as follows:

Section at Belle, Cabin Creek District.

	Thickness Feet.
Coal, No. 2 Gas—	
Slate and shale	7
Sandstone, massive, Brownstown	45
Sandy shale, etc.	25
Coal, Powellton, 655' A. T. B.	2

On the head of Cabin creek at the Republic Mine, 3 miles southeast of Decota, the following section is exposed, showirg the Brownstown sandstone:

Section at Republic, 3 Miles Southeast of Decota, Cabin Creek District.

	—Thickness— Ft.	In.
Coal, No. 2 Gas	5	6
Slate and shale	3	0
Sandstone, massive, Brownstown	25	0
Shale and slate	4	0
Coal, Powellton	1	6

The foregoing sections represent the stratigraphic relations of the **Brownstown sandstone** in Kanawha county.

The Powellton Coal.

At 25 to 80 feet under the **No. 2 Gas coal** occurs another bed of coal that is fairly persistent throughout the southern part of Kanawha county, that was first designated the **"Brownstown coal"** by Dr. I. C. White, but later as the coal was first developed on a commercial scale at Powellton, a mining village in Fayette county 35 miles southeast of Charleston, Dr. White rechristened the bed the **Powellton coal.**

It is possible that this bed, like the **Peerless,** is a split from the **No. 2 Gas seam,** since the **No. 2 Gas** and the **Powellton** occur rarely, if ever, of commercial thickness in the same hill or near each other. The coal is usually of a soft columnar type, low in sulphur and ash and is a good coking, fuel, and by-product coal.

The following section taken in the Powellton mine of the Mt. Carbon Coal Company, Limited, shows thc general structure of the coal at the place where the bed derived its name.

Section of Powellton Coal, Powellton, Fayette County.

Slate roof—	—Thickness— Ft.	In.			
Coal, soft, gas	0	4			
Slate, black	0	1			
Coal, soft, columnar	2	8			
Bone	0	4	**Powellton**		
Coal, gas	1	3	**Coal**	7′	5″
Slate	...	2			
Coal, soft, gas	2	7			
Slate floor.					

Another section measured on the north side of the Kanawha river at Montgomery, Cabin Creek district, shows the following structure:

		—Thickness— Ft.	In.
Sandstone, massive, Brownstown—			
Slate		3	0
Coal, soft .....2'-0"			
Slate .....1'-0"	..	3	4
Coal, impure .....0'-4"			

The coal is usually multiple bedded.

This coal is mined by the Lackawana Coal & Lumber Co., on Paint creek at the Grose No. 2 Mine, where the following section was measured:

Section of Grose Mine No. 2, Cabin Creek District.

		—Thickness— Ft.	In.
Sandstone, massive.....		4	4
Slate.			
Coal, soft .....0'-6"			
Slate, dark gray ....0'-3"			
Coal ..... 4"			
Slate, gray ..... 1"			
Coal, soft ..... 8"	Powellton Coal..	6	10
Slate ..... 1"			
Coal, hard .....1'-2"			
Bone .....0'-1"			
Coal, columnar, gas..3'-8"			
Elevation. 1515' A. T. B.			

The foregoing sections give the general structure of the Powellton coal in the Kanawha area. Other sections of this coal will be given in a subsequent chapter.

The interval of 60 to 150 feet between the **Powellton bed** and the next lower coal bed is made up of shales and sandstones, often holding a silicious limestone, near the center. These shales and sandstones are dull grayish or dove-colored, and the shales often contain small iron nodules or concretions. The sandstones are often massive, but are frequently displaced with the shales, and sometimes contain a small bed of coal, as exhibited in the following section, taken at North Carbon on Cabin creek:

Section at North Carbon, Cabin Creek District.

	—Thickness— Ft.	In.
Coal, No. 2 Gas	5	6
Sandstone and concealed	37	0
Coal, Powellton	0	7
Fire clay and shale	57	0
Coal	0	3
Sandstone, massive	100	0
Coal, Eagle	4	6

At the mouth of Morris creek and on the north side of the Kanawha river at Montgomery, in the quarry where the stone for Lock No. 2 was obtained, the following section was measured by Dr. I. C. White, and published in Vol. II, page 526, West Virginia Geological Survey, 1903.

Section at Montgomery, Cabin Creek District.

	—Thickness— Ft.	In.
Coal blossom, Peerless—		
Shales	40	0
Coal	0	4
Shales	15	0
Coal 4'-6" / Slate 0'-4" / Coal 0'-8" } No. 2 Gas	5	6
Fire clay and sandy shales	5	0
Sandstone, massive Brownstown	35	0
Coal, Powellton	1	8
Concealed and shales	35	0
Limestone, Cannelton	2	4
Shale and concealed	55	0

The Cannelton Limestone.

Dr. I. C. White gives the following in Vol. II(A), pages 348-349, West Virginia Geological Survey, 1908, in regard to this bed:

"A thin bed of impure limestone is often found in the Kanawha Valley at 35 to 50 feet above the **Eagle coal bed**, and 75 to 100 below the **No. 2 Gas coal**. It is rather silicious and usually non-fossiliferous. Some hydraulic cement was once manufactured from it near Cannelton on the north side of the Kanawha river, opposite Montgomery, by a Mr. Stockton, and hence it is often known as the **"Stockton cement bed."** This may be one of the silicious limestones that often crop along the waters of Big and Little Coal rivers between the **Eagle** and **No. 2 Gas coals**. It, like the Eagle limestone, below the **Little Eagle**

PLATE XXIV.—Scene on Kelly Creek at Ward, showing Kanawha Series.

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coal, often exhibits the 'cone-in-cone' structure, and hence its identification outside of the immediate valley of the Kanawha river, is as yet problematical except where the succession of the overlying coal beds is clear and distinct enough for exact identifications."

The following section was measured at the mouth of Staten run, on the north side of Kanawha river opposite Montgomery, showing the location of the **limestone** in connection with the underlying coals:

Section at Mouth of Staten Run.

		—Thickness— Ft.	In.
Coal, No. 2 Gas		5	0
Sandstone and concealed, Brownstown		35	0
Coal ..... 1'-6"			
Fire clay and shale..... 2'-0"	**Powellton**	4	0
Coal ..... 0'-6"			
Sandy shale and sandstone		35	0
Limestone, Cannelton		2	3
Shales and sandstone		35	0
Coal, Eagle, 620' A. T. B.		1	0

No trace of this limestone was found on Paint or Cabin creeks where its horizon comes above the surface.

The Eagle Coal.

At from 60 to 160 feet under the **Powellton coal,** and from 115 to 230 feet under the **No. 2 Gas coal,** there appears another bed of coal varying in thickness from 3 to 8 feet that has been designated the **Eagle coal bed** from a small mining village of that name in Fayette county, 4 miles southeast of Montgomery on the C. & O. Ry., where this coal was first mined on a commercial scale by Capt. Wm. Wyant, about 1882.

Dr. I. C. White gives the following description of this bed in Vol. II, page 587, West Virginia Geological Survey, 1903.

"The Eagle seam is a soft coal of the 'gas' type, as compared with the 'splint' coals in the upper half of the Kanawha series, having the columnar structure of typical coking coal without any splinty layers whatever. Its physical character very much resembles the Pottsville coals of New river, and hence we find it making excellent coke, as well as good steam coal. It contains less volatile matter, but more fixed carbon than the **Campbells Creek or No. 2 Gas coal** above it, with practically the same percentages of ash, sulphur and phosphorus."

The following is a section of the Eagle coal measured in the mine of Capt. Wyant (now Mecca Colliery Company) at Eagle, Fayette county, as given in Volume II, West Virginia Geological Survey, page 531:

	Ft.	In.		
Coal	0	2		
Niggerhead	0	2		
Coal	0	10		
Shale	0	1		
Coal	0	2½	4′	6½″
Shale	0	3		
Coal	2	4		
Cannel	0	2		
Coal	0	4		

"The streak of cannel near the bottom of the seam is not always present."

This coal first comes above the Kanawha river at the crest of the Warfield anticline near the mouth of Lens creek at Marmet, where the coal has been mined for local fuel by M. Snodgrass. The following section was measured there:

Section of Eagle Coal at Marmet.

		—Thickness— Ft.	In.
Medium coarse sandstone		20	0
Coal, soft .....0′-3″			
Fire clay.....0′-0½″			
Coal, soft, gas ....0′-7″	Eagle Coal	1	4½
Fire clay .....0′-1″			
Coal, gas .....0′-6″			
Slate floor. Elev. 590′ L.			

The coal goes under the Kanawha river to the southeast at the Coalburg syncline, and does not come above the surface of the river again until near the mouth of Morris creek, just east of Montgomery, where it is mined by Wm. Rigg at the level of the creek, for local fuel coal, and is 3 feet thick with two small partings.

The Eagle coal has recently been opened and is mined by the Cannelton Coal Company at the mouth of Blakes Branch on Smithers creek, and ¼ mile east of the Kanawha-Fayette county line, where the following section was measured:

Section of Eagle Coal, Mouth of Blakes Branch, 1 Mile Northeast of Cannelton.

Slaty sandstone—	—Thickness— Ft.	In.		
Coal, impure	1	2		
Slate	1	2		
Coal	0	1		
Slate	0	10		
Coal, impure	0	6	6′	3″
Slate	0	2		
Coal, gas	1	2		
Slate	0	2		
Coal, gas, 640′ A. T. B.	2	0		

The Eagle coal is mined on Cabin creek by the Carbon Coal Company at Nabob, 1 mile northwest of Decota, where the following section was measured:

Section of Eagle Coal, Nabob, Cabin Creek District.

	—Thickness—			
1 Sandstone, massive—	Ft.	In.		
2 Coal, impure	1	6		
3 Fire clay	2	0		
4 Slate	0	4		
5 Coal, soft, gas	1	3	10′	6″
6 Fire clay	1	3		
7 Coal, gas	1	7		
8 Slate, sulphurous	0	1		
9 Coal, gas, good, 1130′ A. T. B.	2	6		

Nos. 5, 7 and 9 are mined.

The Eagle coal comes to the surface of Paint creek near Wacomah and rising rapidly is mined at Detroit by the Lackawana Coal & Lumber Company at an elevation of 220 feet above the level of the creek, where the following section is exhibited:

Section of Eagle Coal, Detroit, Cabin Creek District.

Sandstone—	—Thickness— Ft.	In.		
Coal, soft, gas	0	4		
Slate, gray	0	1½		
Coal, soft, gas	0	1½		
Fire clay, hard, gray	0	8	4′	6″
Coal, soft	0	4		
Coal, block	0	4		
Coal, soft, gas	1	1		
Coal, splint	1	6		

Fire clay floor, 940′ A. T. B.

The coal continues rising rapidly above the bed of Paint creek to the southeast until at Hickory Camp mine, 8 miles southeast from Detroit the coal is 450 feet above the level of the railroad. The following section was measured there:

Section of Eagle Coal, Hickory Ash, Cabin Creek District.

	—Thickness—			
Sandstone, massive—	Ft.	In.		
Slate	1	4		
Coal, cannelly	0	3		
Coal, soft	1	3		
Slate, gray	0	4	5′	2″
Coal, hard	0	3		
Slate, gray	0	8		
Coal, soft, gas, 1360′ A. T. B.	3	1		

The Eagle coal in mined by the Solvay Colliery Company at Keeferton, 3 miles southeast of Hickory Camp and 2 miles east of the Kanawha-Fayette county line, at an elevation of 750 feet above the level of the railroad, where the following section was measured:

Section of Eagle Coal, Keeferton, Fayette County.

	—Thickness—			
Sandstone, massive—	Ft.	In.		
Coal, soft	4	5		
Slate	0	1	7′	0″
Coal, hard, 1960′ A. T. B.	2	6		

The foregoing sections give the general structure and character of the **Eagle coal** in the area under discussion. Other sections will be given in a subsequent chapter.

The Decota Sandstone.

At 2 to 5 feet under the Eagle coal there appears a massive sandstone, from 15 to 25 feet thick that the writer has designated the **Decota sandstone** from a mining village of that name on Cabin creek, where the sandstone appears in the bank of the creek. The sandstone is grayish brown, of medium fine grain and often current bedded.

The following section, measured at Decota, shows its position with reference to the overlying strata:

Section at Decota, Cabin Creek District.

	—Thickness— Ft.	In.
Coal, Eagle—		
Sandstone, massive	25	0
Coal, Little Eagle	2	6
Slate floor, 1130' A. T. L.		

The Decota sandstone frequently changes into sandy shale in the lower portion of the stratum.

The following section measured at Crescent, one mile southeast of Montgomery in Fayette county, and ¼ mile south of the Kanawha-Fayette county line exhibits the sandstone at that point:

Crescent Section, Fayette County.

	—Thickness— Ft.	In.
Coal, Eagle—		
Fire clay	4	0
Sandstone, massive, Decota	19	0
Coal, soft, Little Eagle	1	9

The Little Eagle Coal.

At 20 to 50 feet under the Eagle coal there occurs another small bed of coal designated the **Little Eagle Coal** by Dr. I. C. White.

This bed is from 1 to 3 feet thick, and is a columnar coal, soft, and of a gas and coking type. The sections given on previous pages of this volume represent the general thickness and occurrence of this coal. At Decota this bed appears in a railroad cut, 30" thick, and appears to be good, clean coal.

One-half mile south of Decota in the railroad grade, the following section is exposed:

Section ½ Mile South of Decota.

	—Thickness— Ft.	In.		
Coal, Eagle—				
Slate	0	4		
Sandstone, massive	4	0		
Slaty sandstone	6	0		
Coal, Little Eagle	1	8		
Fire clay	0	1	3'	2"
Cannel bone	0	2		
Coal, visible	1	3		

The **Little Eagle coal** is not mined on a commercial basis in Kanawha county.

The Eagle Limestone, "Black Marble."

At from 40 to 50 feet under the Little Eagle Coal, and separated from it by shales and sandstone, there occurs a dark limestone and limy shale, which Dr. I. C. White has designated the **Eagle Limestone**, and Maj. Wm. Page once named it the "Black Marble."

At Edgewater, 1.3 miles southeast of Montgomery in Fayette county, and ½ mile south of the Kanawha-Fayette county line the following section is exposed:

Edgewater Section, Fayette County.

	—Thickness— Ft.	In.
Coal, Little Eagle	1	8
Fire clay, impure	5	0
Sandstone and sandy shale	50	0
Limestone, Eagle, (Black Marble)	1	0
Dark bituminous shale, fossiliferous, 650' A. T. B.	5	0

This bed was not recognized by the writer in Kanawha county.

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*"The Eagle Limestone is known locally as the 'Black Marble,' but it is simply an impure limestone darkened with carbon, and exhibiting the 'cone-in-cone' structure. The bituminous shales under it are filled with marine fossils, Productus Nebrascensis P. Longispinus, Spirifer Cameratus, Euomphalus and many other forms being present.

Vol. II, West Va. Geological Survey, page 531, 1903.

The War Eagle coals (Upper, Lower and Middle) were not recognized in the study of the measures in Kanawha county. The Eagle coal is 475 feet above the level of Paint creek, at Hickory Camp, ½ mile east of the Kanawha-Fayette county line, which would give interval enough for the Upper and Middle coals to be exposed. However, no evidence of these coals was found by the writer.

PART III.

The Mineral Resources of Kanawha County.

CHAPTER X.

PETROLEUM AND NATURAL GAS.

EARLY HISTORY.

The Kanawha Valley was early noted for its natural gas, even before the white man had invaded the region. It is quite probable that the "burning springs", an outflow of natural gas and salt water, along the Kanawha river, where the Warfield anticline crosses the river, 9 miles east of Charleston, had already attracted the attention of the native Indians and they were making use of them in their own primitive way long before the white man had crossed the Alleghanies.

Historians claim that Gen. George Washington visited the Kanawha Valley as early as 1775, and while camped at the "burning springs" (now Washington Springs), nine miles east of Charleston, preempted the spring along with other lands given to him for military service by the State of Virginia, and that in his will this natural gas wonder, including one acre of ground around it, was deeded to the public forever in the following language:

"The tract of which the 123 acres is a Moiety, was taken up by Gen. Andrew Lewis and myself, for and on account of a bituminous spring which it contains of so inflamable a nature as to burst forth as freely as spirits and as nearly difficult to extinguish."

The following interesting account of the early drilling machinery and methods invented in the Great Kanawha Valley is given by Dr. I. C. White[1]:

Drilling Machinery and Methods Invented in the Great Kanawha Valley.

"It is not generally known that all of the essential elements of the petroleum industry of the United States really originated in what is now West Virginia, but such is the truth of history. It was in the Great Kanawha Valley at Salt, or Buffalo Lick, near Charleston, where, under the intelligent and successful attempts of the Ruffner brothers (David and Joseph) to bore down through the rocks and ascertain the source of the famous salt spring, that modern drilling tools, jars, casing, and practically all of the oil well machinery in use at the present day were invented. These boring operations were begun by the Ruffner Bros. (David and Joseph) in 1806, and their efforts were crowned with success on the 15th day of January, 1808. The story of these early drilling operations and inventions has been given in a detailed and interesting sketch by Dr. J. P. Hale, president of the West Virginia Historical Society, Charleston, W. Va., in the 'Resources of West Virginia.' 1876, by M. F. Maury and Wm. M. Fontaine, Chapter XII, pages 274-305, and as that volume is now out of print, the main portion of the chapter is reproduced, beginning with page 273, in Volume I(A), W. Va. Geol. Survey, to which the reader is referred."

Natural Gas First Used for Manufacturing Purposes in the Kanawha Valley.

"From these facts as given by Dr. Hale, it will be perceived that the claim of priority for West Virginia in all of the essential elements of the petroleum industry of the United States, is fully sustained, for here were invented practically all of those tools and appliances without which the deep drilling of the present day would be impossible. This record also shows that the use of natural gas for manufacturing purposes was first begun within the United States by Mr. Tompkins of the Kanawha Valley, a utilization which now plays such an important part in industrial affairs, and which is destined to continue until the age of gas is fully inaugurated, and the general use of coal in its crude or unmanufactured condition is abandoned in all populous communities. The extravagant methods which have characterized the first decade of the recent greatly increased use of natural gas, will have been largely compensated for, should they finally lead to the use of coke instead of coal, and to the saving of the gas for fuel and general heating purposes which is now lost in our wasteful and unscientific coke ovens of the bee-hive pattern."

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[1]Vol. I(A), Pages 2 to 14, West Virginia Geological Survey, 1904.

Petroleum Discovered in the Early Salt Borings.

"In these early salt borings on the Great Kanawha, considerable quantities of petroleum were often found in the sands of the Coal Measures (Pottsville series), and much of it was utilized in oiling machinery and for torch lights, while many barrels of it were transported and sold to other regions."

All oil and gas yet discovered in West Virginia, with one or two exceptions, has been produced from sandstone beds called "sands" by the oil fraternity.

These sands have been given various names by the oil and gas operators, which have gradually come into general use in describing the beds.

The following by Dr. I. C. White, with some modifications by the writer shows the position of the various sands in the geologic column.

The Oil and Gas Horizons of West Virginia.

Carboniferous	Monongahela Series.	Carroll sand (Uniontown).
	Conemaugh Series.	Minshall (Connellsville) Murphy (Morgantown). Moundsville (Saltsburg). First Cow Run (Little Dunkard) sand (Buffalo). Big Dunkard sand (Mahoning).
	Allegheny Series.	Burning Springs (Upper Freeport) sand. Gas sand (Lower Freeport).
	Pottsville Series.	Gas sand of Marion and Monongalia counties (Homewood), Second Cow Run of Ohio. Gas sand of Cairo. Salt sand of Cairo. Cairo?
	Mauch Chunk Red shale.	Maxton, Dawson, Cairo.
	Greenbrier Limestone.	"Big Lime," not generally productive.
	Pocono Sandstones.	Keener sand and Beckett sand of Milton. Big Injun sand. Squaw sand (Weir). Berea Grit.
Devonian	Catskill Red Beds.	Gantz sand. Fifty-foot sand. Thirty-foot sand. Stray sand. Gordon sand. Fourth sand. McDonald or Fifth sand. Bayard or Sixth sand.
	Chemung and Portage Beds.	Warren First or Second Tiona, Speechley sand. No well defined oil or gas horizon yet discovered in West Virginia.

In Jefferson district on Browns creek gas in paying quantities has been found in the "Big lime." In the Blue Creek Oil field, oil in paying quantities has been found in the Squaw sand, and in the gas field in Big Sandy district gas is found in the Big Injun. Gas is also found in the Big lime in the Blue Creek Oil field. In the northern and central parts of West Virginia, the "oil sands" are generally referred to the **Pittsburgh Coal bed** as a key rock to determine their identity. In Kanawha county there is only a limited portion in the northern part of the county, where the **Pittsburgh bed** is present, this coal being absent over a larger portion of the area of Kanawha county. Another factor that enters is the **rapid thickening** of the **Pottsville series** to the southeast, which will make this interval vary considerably at different parts of the county, but the following table gives the approximate interval between the top of the **Pittsburgh coal** and top of the **Big Lime** and tidal elevation of the **Big Lime** at different points of Kanawha county:

Table showing interval between top of Pittsburgh coal, top of Big lime and tidal elevation of Big lime.

Nearest P. O.	Name of Well	Dist.	Interval	Elevation Big Lime A. T.
Island Branch....	Jones No. 1.....	Poca	1510	928
Sissonville.....	Milam.....	Poca	1557	894
Lewis.....	C. & A.....	Jefferson	1680	725
Tornado.....	Yoder No. 1.....	Jefferson	1797	747
Charleston.....	Kan. Water & Light Co.....	Charleston	1850	650
Mink.....	Lory No. 1.....	Elk	1832	672
Blue Creek.....	Ethel Price No. 5..	Elk	1910	810
Clendenin.....	Ed. Jarrett.....	Big Sandy	1928	690
Marmet.....	Gould and Parker No. 2.....	Loudon	2455	355
Carpenter.....	Carpenter No. 1..	Elk	2000	523
Queen Shoals....	L. D. Graham No. 2	Elk	2284	649
Dana.....	W. D. Lewis No. 1.	Malden	2171	356
Shrewsbury.....	R. F. Watson No. 1	Cabin Creek	2635	708
Mucklow.....	Paint Creek Land Co. No. 1..	Cabin Creek	2955	920
Powellton.....	Mt. Carbon No. 1	Fayette Co.	3547	695
Dixie.....	Heavener No. 1..	Fayette Co.	2212	812

From the above table it will be seen that the interval be-

tween the top of the **Pittsburgh coal** and top of **Big lime,** varies in Kanawha county from 1510 feet in the northwestern part of the county to 3547 feet at Powellton, Fayette county, 3 miles east of the Kanawha-Fayette county line, an increase of 2037 feet in 37 miles S 21° 45′ E, or about 55 feet per mile, while the tidal elevation of the **Big Lime** in this distance has risen only 233 feet.

DESCRIPTION OF SAND.

The highest producing sand thus far found in Kanawha county is the **Salt sand.** The Moundsville, the first Cow Run (Little Dunkard) sand, the Big Dunkard sand, and the Second Cow Run sand, have not yet produced any oil or gas in Kanawha county. In Loudon district, on Davis creek in the J. H. Huling well (639) a showing of oil and gas was found in a white sand, 25 feet thick at a depth of 195 feet, and at an interval of 470 feet under the **Kanawha Black Flint.**

The Salt Sand.

The Salt Sand of the drillers in West Virginia usually constitutes the main portion of the Pottsville beds, and has been so named on account of a large quantity of **salt water** generally encountered therein. It is frequently divided into three or more divisions called the **First, Second** and **Third** Salt Sand. It is a very important oil and gas horizon in West Virginia. On Davis creek, oil was encountered in this sand, at a depth of 800 feet, and about 975 feet under the Kanawha Black Flint. This sand also furnished the brine for the salt furnaces along the Kanawha and Elk rivers in the early days when the salt industry was flourishing.

The Maxton Sand.

The **Maxton Sand** occurs in the **Mauch Chunk** series a short distance above the "Pencil Cave" of the drillers. This sand has produced oil in several counties of the State, including a recent strike near Belva in Nicholas county, but the most productive field at this horizon is found near Burton in the

northeast corner of Wetzel county. In Kanawha county this sand is 20 to 40 feet thick, but no oil or gas has thus far been found in paying quantities therein.

The Big Lime.

The Greenbrier limestone or "Big lime" of the drillers has produced gas in Kanawha county on Browns creek in Jefferson district and in Poca district, on Grapevine creek east of Sissonville, and on Lens creek in Loudon district. This stratum is from 125 to 225 feet thick in Kanawha county, and occurs from 1510 to 3547 feet under the Pittsburgh Coal horizon.

The Big Injun Sand.

The Big Injun Sand comes under the Greenbrier limestone, and is often separated from it by 20 to 40 feet of shale. Owing to its location it is one of the easiest sands to be identified by the West Virginia drillers. In the northern part of West Virginia this sand attains a thickness of 300 feet. Often 30 to 40 feet of the uppermost part is separated from the main bed by 5 to 15 feet of dark shale or slate. This top portion was designated by drillers the **"Keener Sand"** from a farm by that name on which the first oil well at this horizon was obtained, in the Sistersville oil field. When the bottom portion is separated from the main bed by a bed of slate from 15 to 50 feet thick, this basal portion is called the **"Squaw Sand."** This is the sand that holds the oil and gas in the Blue Creek Oil field. There the sand is 5 to 30 feet thick and is coarse and pebbly. The first wells that encountered this sand, on Blue creek, produced 500 to 2,000 barrels of oil per day.

The Wier Sand.

At 350 to 390 feet under the top of the Big lime there occurs a sand that is producing oil and gas in Big Sandy district, that has been designated the **"Wier Sand,"** since oil and gas were first produced from this sand by the Falling Rock Cannel Coal Co. near Wier, Kanawha county. This is the

producing sand in the Hackberry field, and is possibly the same as the "Squaw" of Blue Creek.

The Berea Grit.

At 475 to 675 feet under the top of the Greenbrier limestone occurs the **Berea Grit,** the basal member of the **Pocono sandstone group.** This is the sand that produces the oil in the Griffithsville oil field in Lincoln county, and produces gas in the Browns creek field in Jefferson county, also oil at Tornado in the Yoder Well No. 1.

The sands in the Devonian, the Gantz, the Fifty-foot, the Thirty-foot, the Gordon Stray and the Gordon sands have not been encountered in Kanawha county.

OIL AND GAS DEVELOPMENT IN KANAWHA COUNTY.

The history of Kanawha county shows that traces of oil and gas were found in the Kanawha valley at a very early date in the 18th century, but no oil was found in paying quantities, in Kanawha county, until the discovery of the Blue Creek oil field in the latter part of 1911, when the Ohio Fuel Oil Company drilled the Swartz & Barth No. 1 (202), located S 30° E, ½ mile from Blue Creek station. Gas has been produced for years along the Kanawha valley east of Charleston, and on Browns creek in Jefferson district; in Loudon district on Lens creek; in Elk district on Coopers creek; and in Big Sandy district north of Clendenin. These and other minor fields will be discussed more fully on subsequent pages of this report.

WELL RECORDS.

The principal source of information in regard to the thickness and character of the different formations of economic interest where they lie deeply buried below drainage in Kanawha county, has been the logs or records of the many wells bored for oil and gas and coredrill holes for coal, by both individuals and corporations. Through the courtesy of the latter,

the writer has been enabled to collect the records of a large number of wells and coredrill holes, on which levels were taken in the field while gathering data for this report. A large number of these records are incomplete, in that often only the principal oil and gas horizons are noted.

It is very important that an accurate and detailed record of the depth, thickness and character of all **coals, red beds, limestones, dark slates, oil and gas pays** as well as the depth where water is found, be kept while drilling.

In the preface of Volume I(A), West Virginia Geological Survey, 1904, Dr. I. C. White fully sets forth the importance of this fact.

The accompanying table contains the principal coals, oil and gas sands, of wells in Kanawha county, as also the tidal elevation of wells, the records of which were not attainable at this time.

The wells are numbered consecutively from 1 to 831 and grouped largely by magisterial districts, the serial number in each case corresponding to the map numbers of the same well as located on the economic geology map accompanying this report.

In the elevation column the letter "B" indicates that the elevation of the top of the hole was obtained by aneroid, checked with nearby United States Geological Survey spirit level elevation; the letter "L", by spirit level measurements. The elevations of the top of the hole are expressed in feet above tide. Depth and thickness of the formations are given in feet.

Berea Sand		Total Depth	Producing Sand	REMARKS
Thickness	Depth (Top)			
.....	.....	1662	Squaw.....	Oil well.....
.....	.....	1670	Squaw.....	Oil well.....
.....	.....	.....	Squaw.....	Oil well.....
.....	.....	.....	Squaw.....	Oil well.....
.....	.....	1685	.....	Dry hole, little gas 1663'-1689'.....
.....	.....	1731	Squaw.....	Dry hole, slight showing of oil and gas.....
.....	.....	.....	Squaw.....	Oil well.....
.....	.....	1687	Squaw.....	Oil well.....
.....	.....	.....	Squaw.....	Oil well.....
.....	.....	.....	Squaw.....	Oil well.....
.....	.....	.....

The foregoing table is very convenient for ready reference in regard to the depth and thickness of the various coals and the Big lime, Big Injun and Squaw sands. However, it is of great importance that the complete record of a number of these wells be given, not only to preserve them from loss, but for the large fund of information they contain as to the presence or absence of the different coal beds, as well as all the oil and gas horizons. The accurate location of any tabulated well is readily determined by its serial, or map number, published in the table, and with the heading in parentheses where the complete record is given, also on the economic geology map, (accompanying this report in a separate cover) and for the Blue creek oil field wells on Fig. 10 of this volume.

Oil and gas have been produced in every district in Kanawha county except in Washington. The well records along with a description of the several fields, and their relation to geologic structure, will now be taken up by magisterial districts.

POCA DISTRICT.

Poca district occupies the northern portion of Kanawha county, and a glance at the map shows that the Milliken anticline passes through the eastern part of the district. In the western and central part of the district no unusual geologic movements have taken place, as indicated by the structural map. However, it will be noticed that south of Pocatalico river the strata rise more rapidly than north of the river, showing that a small terrace passes northeast and southwest, almost parallel to the river.

No productive oil or gas pool has yet been found in this district. Some gas has been found in the Big Lime in the F. E. Boggess well (601) on Grapevine creek, two miles east of Sissonville.

The logs of several wells scattered over different parts of the district will now be given.

Dr. Jones Well No. 1, Well Record (600).

Located in Poca district, one mile north of mouth of Island Branch. Authority, Crawford & Ashby, Charleston, W. Va. Completed April 23, 1909. Mead Brothers, contractors. Elevation 680' A. T. L.

	Thickness Feet.	Total Feet.
Conductor	18	18
Slate	152	170
Coal, Elk Lick	2	172
Slate	48	220
Sand	10	230
Red Rock	80	310
Rock, pink, and slate	240	550
Sand	30	580
Lime, sandy	85	665
Lime, dark	15	680
Sand, dark	70	750
Coal	3	753
Slate, black	12	765
Sand	10	775
Lime	10	785
Sand	45	830
Slate, brown	25	855
Sand	10	865
Shale, brown	60	925
Lime, sandy	15	940
Sand	95	1035
Shale, black	70	1105
Sand	10	1115
Shale, black and lime shells	95	1210
Sand	10	1220
Shale, black and lime shells	15	1235
Salt sand	305	1540
Little Lime	55	1595
Pencil cave	13	1608
Big Lime	125	1733
Big Injun sand	52	1785

"10" casing, 18'; 8¼" casing, 320'; 6⅝" casing, 1613'; water enough to drill at 695'; water at 1320'; a little gas in Big Lime, 1665' to 1670'; gas and show of oil, 1685' to 1690'; show of oil in Big Injun, 1733' to 1745'. 15 feet of Big Injun sand of fair quality, the balance rotten and shelly. Well, dry and abandoned."

Several years ago Messrs. Humphrey and Cox drilled a test well in the village of Sissonville. The records show that the well was not drilled through the Big lime.

The following is the record as furnished the writer:

Humphrey Well Record (602).

Located in Sissonville, Poca district. Authority, Messrs. Humphrey & Cox, Charleston, W. Va. Elevation 624' A. T. B.

	Thickness Feet.	Total Feet.
Surface	33	33
Sand	15	48
White slate	45	93
Red rock	27	120
White slate	88	208
Red rock	192	400
White sand, Saltsburg-Buffalo	80	480
Black slate and shale	490	970
White sand	25	995
Lime (?)	50	1045
Salt sand	400	1445
Pencil cave	18	1463
Big Lime	85	1548

"Well dry and abandoned."

It began about 80 feet under the Pittsburgh coal horizon.

On the waters of Grapevine creek, two miles east of Sissonville, the Ohio Fuel Oil Company drilled the T. E. Boggess well No. 1, and found a gas well in the Big lime.

T. E. Boggess No. 1 Well Record (601).

Located on Grapevine creek two miles east of Sissonville. Authority, Ohio Fuel Oil Company. Completed March 8, 1912. Elevation 900' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	15	15
Red rock	135	150
Sand, Lower Pittsburgh	60	210
Red rock	100	310
Slate and shells	270	580
Sand, Saltsburg	50	630
Slate	30	660
Sand, Buffalo	40	700
Slate and shells	100	800
Black slate	172	972
Lime and slate	33	1005
Sand	45	1050
Slate and shells	70	1120
Salt sand	487	1607
Slate	2	1609

	Thickness Feet.	Total Feet.
Little Lime	30	1639
Pencil Cave	2	1641
Big Lime	82	1723
Total depth	...	1723

"Some gas at 1290'; water at 1300'; gas pay, 1712'-1715'. Gas well."

The well begins 150 feet above the Pittsburgh coal horizon. This will make the interval between the base of the Pittsburgh sandstone and top of Big Lime, 1491 feet at this point.

On Pocatalico river one-half mile east of mouth of Derrick creek, the Carter Oil Company drilled a well on the W. S. Beane farm, where the following record was obtained:

W. S. Beane No. 1 Well Record (608).

Located in Poca district 2.5 miles southeast of Sissonville. Authority, Lee Cady Spencer. Well completed, 1910. Elevation 615' A. T.

	Thickness Feet.	Total Feet.
Clay	5	5
Sandy loam	15	20
Gravel	15	35
Red rock	15	50
Lime	20	70
Sand	20	90
Water	40	130
Sand	10	140
Red rock	20	160
White slate	65	225
Red rock	15	240
White slate	10	250
Red rock	20	270
White slate	5	275
Blue sand	10	285
Brown clay	5	290
Red rock	20	310
White slate	5	315
Red rock	5	320
Sand, Saltsburg	20	340
White slate	10	350
Coal, Bakerstown	2	352
White slate	43	395
Sand	40	435
White slate	145	580
Black slate	20	600
Sand	40	640
Black slate	215	855
White slate	10	865

	Thickness Feet.	Total Feet.
Black slate	60	925
Sand	30	955
White slate	15	970
Lime	10	980
First Salt sand	127	1107
Coal, Sewell	3	1110
Third Salt sand	335	1445
Little Lime	13	1458
Pencil cave	3	1461
White lime	7	1468
Pencil cave	4	1472
Big Lime	73	1545
Keener Sand (?)	10	1555
Big Lime	45	1600
Big Injun sand	85	1685
Slate and shells	65	1750
Sandy lime	70	1820
Slate	175	1995
Lime shells	20	2015
Slate	95	2110
Brown lime	10	2120
Sand and shells (Berea)	10	2130
Slate and shells to bottom	93	2223

"13" casing, 24' 3"; 10" casing, 340'; 8" casing, 860'; 6⅝" casing, 1480'; water at 80'; 2 bailers water, 1075'; hole full water, 1105'; show gas, 1636'; dry hole, well abandoned."

The well starts about 105 feet under the Pittsburgh coal horizon. The sand at 70 feet is possibly the Morgantown sandstone, and the coal encountered at 350 feet is possibly the Bakerstown.

On Right Hand Fork of Derrick creek, 3¼ miles northwest of Sissonville, Messrs. Cox and Humphrey drilled a well to a depth of 4,000 feet. The sands were broken and according to Mr. Cox no accurate record was kept of the drilling.

Prospective Oil and Gas Territory, Poca District.

There yet remains quite a large acreage of undrilled territory that has not been tested, in Poca district, that appears to be within limits favorable for oil or gas if the lower sands are not broken up. There appears to be quite a terrace in the rocks between Sissonville and Island Branch P. O. along Pocatalico river north of the Boggess No. 1 well, which may possibly contain oil or gas.

UNION DISTRICT.

Union district lies west of Poca and extends to the Kanawha river on the south. The Guthrie syncline extends in a northwest direction for a short distance into the southeastern part of the district, but as in Poca district no great geological disturbance has taken place therein, but several small crumples occur south of Pocatalico river

In the last few years several tests have been made by different companies for oil and gas in this district, but thus far no wells of economic value have been found. The following is the record of one of these tests:

J. W. Franklin Well Record (612).

Located in Union district, 2¼ miles northwest of Sattes. Completed, 1910. Authority, Carter Oil Company. Elevation 770' A. T. B.

	Thickness Feet.	Total Feet.
Dirt	10	10
Sand	25	35
Red rock	15	50
Sand	10	60
Red rock	20	80
Slate	5	85
Red rock	30	115
Sand	10	125
White slate	3	128
Red rock	4	132
Sand	3	135
Lime	5	140
White slate	45	185
Red rock	10	195
Slate	40	235
Red rock	10	245
Slate	15	260
Sand	25	285
Coal (Bakerstown?)	1	286
Black slate	14	300
Red rock	5	305
Slate	5	310
Lime	5	315
Slate	25	340
Sand	25	365
Slate	10	375
Sand	65	440
Slate	30	470
Sand	15	485
Brown slate	12	497

	Thickness Feet.	Total Feet.
Sand (?)	503	1000
Slate	5	1005
Sand	35	1040
Slate	25	1065
Third Salt sand	470	1535
Little Lime	5	1540
Pencil cave	5	1545
Big Lime	163	1708
Keener sand	10	1718
Slate	12	1730
Big Injun sand	55	1785
Slate	400	2185
Brown shale	18	2203
Berea Grit	18	2221
Slate	8	2229

"2 bailers of water at 20'; 3 bailers of water 532'; 5 bailers of water, 538'; 2 bailers of water, 1070'; 4 bailers of water, 1080'; 6 bailers water, 1090'; hole full of water, 1105'; 3 bailers water, 1740'; show of oil, 1780'; show of oil, 2221'. Well dry and abandoned."

Charles Rust Heirs Well Record.

Located 5½ miles northeast of Sattes, Union district, starting 250 feet below Pittsburgh coal horizon. Authority, Guffy & Galey, Pittsburgh, Pa. Completed, 1910. Elevation, 640' A. T. B.

	Thickness Feet.	Total Feet.
Loose earth	30	30
Slate and shales	190	220
Sand, Buffalo	80	300
Slate	60	360
Sand, East Lynn	130	490
Slate	20	510
Sand	15	525
Slate	20	545
Sand	105	650
Slate	70	720
Sand	15	735
Slate	15	750
Sand, Second Salt sand	40	790
Slate	245	1035
Sand, Third Salt sand	165	1200
Black lime	20	1220
Slate	100	1320
Sand, Maxton	80	1400
Black lime	15	1415
Big Lime	185	1600
Slate	10	1610
Big Injun sand	54	1664

	Thickness Feet.	Total Feet.
Slate and shales	416	2080
Sand, Berea Grit	15	2095
Slate	15	2110

"10" casing, 30'; 8" casing, 253'; 6⅝" casing, 1415'; 5⅝" casing, 1664'; big salt water, 1035'; little oil, gas and water, 1610' to 1611'. Small show of oil in top of Big Injun sand, 1610' to 1615'; large quantity salt water, 1620'. Dry hole, well abandoned."

W. M. Good Well Record (614A).

Located ½ mile southeast from Wallace P. O., Union district. Authority, C. O. G. Company. Well completed December, 1912. Elevation 706' A. T. L.

	Thickness Feet.	Total Feet.
Slate, red, soft	16	16
Gravel, black, open	14	30
Slate, red, soft	12	42
Slate, black, soft	14	56
Lime, white, hard	10	66
Slate, black, soft	10	76
Slate, red, soft	24	100
Slate, black, soft	18	118
Lime, white, hard	10	128
Slate, black, soft	15	143
Lime, white, hard	17	160
Slate, black, soft	15	175
Slate, white, soft	14	189
Slate, black, soft	15	204
Slate, white, soft	14	218
Slate, black, soft	6	224
Lime, white, hard	5	229
Slate, black, soft	5	234
Lime, white, hard	16	250
Slate, black, soft	11	261
Lime, white, hard	40	301
Sand, white, hard	5	306
Slate, black, soft	22	328
Sand, white, hard	30	358
Slate, black, soft	10	368
Sand, white, hard	12	380
Slate, black, soft	8	388
Sand, white, soft	12	400
Sand, white, hard	36	436
Slate, black, soft	7	443
Sand, white, hard	12	455
Lime, white, hard	25	480
Sand, white, hard	55	535
Slate, black, soft	40	575
Slate, white, soft	25	600
Coal, Stockton-Lewiston	6	606

	Thickness Feet.	Total Feet.
White slate, soft	19	625
Sand, white, hard	20	645
Slate, black, soft	60	705
Lime, white, hard	11	716
Slate, white, soft	45	761
Slate, black, soft	20	781
Lime, white, hard	22	803
Slate, black, soft	72	875
Lime, white, hard	22	897
Slate, black, soft	10	907
Sand, white, hard	104	1011
Slate, black, soft	4	1015
Sand, white, hard	242	1257
Lime, white, hard	7	1264
Sand, white, hard, Maxton	40	1304
Gritty lime, white, hard	53	1357
Sand, white, hard	43	1400
Lime, white, hard	60	1460
Slate, black, soft	2	1462
Lime, dark, hard	2	1464
Slate, red, medium	2	1466
Lime, dark, hard	34	1500
Slate, black, soft	5	1505
Lime, dark, hard	35	1540
Slate, black, soft	14	1554
Lime, white, hard	20	1574
Pencil cave	3	1577
Big lime, white, hard	126	1703
Big Injun, gray, soft	90	1793
Slate, gray, soft	28	1821
Sand, Squaw	27	1848
Slate, black, soft	224	2072
Slate, black, soft	99	2171
Shell, gray, hard	4	2175
Slate and shell, soft	49	2224
Sand, Berea Grit	6	2230
Slate and shell, black, soft	74	2304
Total depth	...	2304

"10" casing, 37'; 8" casing 480'; 6⅝" casing, 1585'; 5 3-16" casing, 2224'; water at 42'; more water at 56'; little gas and water at 28'; water, oil and gas in top of Big Injun sand; show of oil at 2224' in Berea Grit, about 1 barrel per day; dry hole; well abandoned."

The above well starts 209 feet under the Pittsburgh coal, so that the coal encountered at 600 feet is possibly the **Stockton-Lewiston coal** of the Kanawha Series.

Dunbar Well Record (620).

Located at Dunbar, Union district. Authority, J. W. Penhale Charleston, W. Va. Published in Vol. I (A), page 500, West Virginia Geological Survey, 1904. Elevation, 607' A. T. L.

	Thickness Feet.	Total Feet.
Conductor	45	45
Sandstone	405	450
Coal, Winifrede	5	455
Sandstone, Lower Winifrede	35	490
Slate and shale	220	710
Sandstone	10	720
Slate and shale	40	760
Sandstone	50	810
Shale	10	820
Lime	35	855
Sandstone	45	900
Coal, Eagle	3	903
Sandstone	7	910
Shale	35	945
Sandstone, Salt	480	1425
Big Lime	213	1638
Slate and shale	25	1663
Big Injun sand	47	1710
Shale	425	2135
Shells and shale	115	2250
Shale	145	2395
Sandstone	5	2400
Shale to bottom	208	2608

The above section starts 415 feet under the Pittsburgh coal horizon; the coal encountered at 450 feet is possibly the Winifrede seam, and the coal at 900 is possibly the No. 2 Gas.

Wythe Haynes Well Record (616).

Located in Union district, 1¼ miles south of Wallace P. O., drilled in 1910. Authority, Guffey & Galey. Elevation 810' A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	995	995
Sand	85	1080
Unrecorded	155	1235
Coal	3	1238
Sand	252	1490
Black lime	12	1502
Unrecorded	153	1655
Big Lime	170	1825

	Thickness Feet.	Total Feet.
Big Injun sand	68	1893
Slate	387	2280
Berea sand	15	2295
Slate	5	2300

"Water 1140' to 1180'; hole full of water, 1825'; dry hole, and well abandoned."

This well begins 115 feet under the Pittsburgh coal; and will make the interval of the Big Lime under the top of the Pittsburgh coal, 1770 feet.

Crawford & Ashby Well Record (622).

Located in Union district, ¾ mile northeast of Lock No. 6. Authority, C. J. VanFleet, Charleston, W. Va. Elevation 650' A. T. B.

			Thickness Feet.	Total Feet.
Conductor			15	15
Clay and slate			55	70
Unrecorded			115	185
Sand			55	240
Red rock (?)			5	245
Slate			4	249
Coal, No. 5 Block			4	253
Fire clay			7	260
Slate and shell			125	385
Sand			55	440
Slate and shell			235	675
Sand			25	700
Slate			75	775
Sand			20	795
Slate and shells			45	840
Sand	40			
Slate	16			
Salt sand	220			
Slate	10	**Salt sand**	595	1435
Sand	202			
Slate and shells	4			
Sand	103			
Slate			5	1440
Sand, Maxton			30	1470
Slate			5	1475
Little Lime			10	1485
Sand			35	1520
Lime	40			
Slate	3	Big Lime	224	1744
Lime	181			
Red rock			5	1749
Sand, Big Injun			36	1785

	Thickness Feet.	Total Feet.
Black sand	10	1795
Slate	9	1804
Sand, Squaw	8	1812
Slate	5	1817
Black sand	25	1842
Slate shells	18	1860
Black sand, hard	125	1985
Slate	90	2075
Black sand	35	2110
Slate and shells	73	2183
Brown shale	19	2202
Sand, Berea	19	2221
Slate and shells to bottom	24	2245

Berea sand, fine, close-grained. Dry hole, and well abandoned.

The above well starts about 475 feet under the Pittsburgh Coal horizon; and this will make the interval between the Pittsburgh coal and top of Big lime, 1995 feet. The "red rock" recorded at 240 to 245 feet is evidently an error of the recorder, since **red beds** have never anywhere been found at that geological horizon.

D. M. Sattes No. 1 Well Record (621).

Located at Sattes station, Union district. Completed April, 1912. Authority, A. R. Rich.

(Elevation, 594' A. T. B.)	Thickness Feet.	Total Feet.
Unrecorded	1370	1370
Big Lime	194	1564
Big Injun sand	62	1626
Unrecorded	403	2029
Sand, Berea. Below tide, 1434'	20	2049
Slate	9	2058
Total depth	...	2058

"Showing of oil in top of Berea; well abandoned."

G. H. Bailey No. 1 Well Record.

Located in Union district, Putnam county, ¼ mile north of Philo and 5.5 miles northwest of the Kanawha-Putnam county line. Completed Sept. 27, 1911. Authority, Ohio Fuel Oil Company.

(Elevation, 1005' A. T. B.)	Thickness Feet.	Total Feet.
Red rock and shells	100	100
Dark slate	45	145
Red rock	60	205

	Thickness Feet.	Total Feet.
Dark slate	23	228
Red rock	42	270
Dark shale	27	297
Coal	3	300
Dark slate	25	325
Red rock	18	343
Sand	12	355
Red rock	90	445
Sand	48	493
Red rock	200	693
Coal, Pittsburgh	7	700
Dark slate	35	735
Lime	15	750
Slate	30	780
Sand	10	790
Slate	10	800
Sandy lime	20	820
Slate	60	880
Sand	35	915
Red cave	45	960
Sand	33	993
Slate	37	1030
Red cave	40	1070
Sand	20	1090
Red rock	20	1110
Sand	5	1115
Slate	108	1223
Sand, Big Dunkard	37	1260
Slate	40	1300
Sand	20	1320
Slate	12	1332
Sand	8	1340
Slate	38	1378
Sand	12	1390
Slate	10	1400
Sand	46	1446
Slate	21	1467
Slaty sand	90	1557
Dark slate	113	1670
Sand	35	1705
Dark slate	132	1837
Sand	55	1892
Slate	3	1895
Little Lime	15	1910
Pencil cave	13	1923
Big Lime	85	2008
Sand, Keener	50	2058
Slate	4	2062
Lime	78	2140
Sandy lime	40	2180
Lime	35	2215
Slate	15	2230
Sand, Big Injun	110	2340
Slate and shells	200	2540

	Thickness Feet.	Total Feet.
Sand and smell of oil	21	2561
Dark slate	116	2677
Brown slate	20	2697
Sand, Berea	7	2704
Slate to bottom	52	2756

"Well dry, and abandoned; hole full of water at 1498'; gas at 2233'; water at 2238'."

Prospective Oil and Gas Territory, Union District.

Union district has not been fully prospected, the several test wells having been drilled at random, and hence there remains a large acreage of territory that is favored by geologic structure, and has not yet been condemned by present development.

By consulting the structural map it will be seen:—(1) That a large acreage of territory remains uncondemned near the center of the district along the Guthrie syncline. (2) That along Tuppers creek the structures are favorable for oil near the head of Wolf Pen Branch, if the lower sands are not broken up, and slaty.

JEFFERSON DISTRICT.

Jefferson district lies southwest of Union and north of Lincoln county, and is the most western district of Kanawha county. The Byrnside anticline runs in a northwest direction, along the western part of the district, and the Saint Albans syncline runs in a northern drection through the center of the same.

Gas has been found in the Big Lime and Berea Sand on Browns creek, in the western part of the district, and oil has been found at Tornado near the southern portion.

J. W. Good No. 1 Well Record (625).

Located 4 miles southwest of Saint Albans, Jefferson district. Completed Dec. 24, 1907. Authority, Kanawha Valley Oil & Gas Company.

The well begins at the level of the Bakerstown coal, so

that the coals encountered at 430 to 450 feet are probably the **Stockton-Lewiston** and **Coalburg.**

(Elevation, 620′ A. T. B.)	Thickness Feet.	Total Feet.
Earth and gravel	33	33
Slate and shells	77	110
Sand	25	135
Slate	10	145
Sand	10	155
Slate and sand	110	265
Sand	95	360
Slate	35	395
Sand	25	420
Slate	10	430
Coal, Stockton-Lewiston	3	433
Slate	17	450
Coal, Coalburg	3	453
Sand	96	549
Slate	21	570
Sand	40	610
Slate	50	660
Sand	60	720
Slate	40	760
Sand	25	785
Slate	22	807
Lime	73	880
Sand	411	1291
Lime, black	30	1321
Lime, white	55	1376
Big lime, dark, to bottom	13	1389

"10" casing, 33′; 8" casing, 270′; 6⅝" casing, 1291′; 5 3-16" casing, 1381′; water at 809 feet; top of gas at 1376 feet; gas well; rock pressure, 600 pounds."

Jarrett No. 1 Well Record (623).

Located 4 1-8 miles southwest of Saint Albans, Jefferson district. Authority, Holly Oil & Development Company. Completed March 28, 1908. Elevation 630′ A. T. B.

	Thickness Feet.	Total Feet.
Gravel and sand	28	28
Slate	47	75
Red rock	25	100
Slate	25	125
Sand	5	130
Slate and shells	40	170
Sand	30	200
Slate	25	225
Sand	100	325
Slate	50	375
Sand	75	450
Slate	40	490
Sand	60	550
Slate	25	575

	Thickness Feet.	Total Feet.
Sand	75	650
Slate	50	700
Black slate	10	710
Sandy lime	112	822
Salt sand	473	1295
Big Lime, gas at 1380'	200	1495
Slate	20	1515
Sand, Big Injun	55	1570
Slate and shells	430	2000
Sand, Berea Grit, to bottom, gas	12	2012

"10" casing, 31'; 8" casing, 160'; 6⅝" casing, 1325'; 5 3-16" casing, 1580'; gas in Big Lime at 1380 feet; volume 1,407, 264 cu. ft.; rock pressure, 300 pounds; gas in Berea."

J. H. Robinson No. 1 Well Record (624).

Located 4½ miles southwest of Saint Albans, Jefferson district, and ¼ mile north of the Jarrett well. Authority, Kanawha Valley Oil & Gas Company. Completed Sept. 30, 1905.

Elevation 635' A. T. B.	Thickness Feet.	Total Feet.
Gravel and sand	28	28
Slate	70	98
Red rock	7	105
Slate	5	110
Sand	10	120
Slate and shells	50	170
Sand	20	190
Slate	40	230
Slate	30	260
Sand, some water	90	350
Slate	30	380
Sand	40	420
Slate	60	480
Sand	85	565
Slate	15	580
Sand	60	640
Sand and slate mixed	50	690
Black slate	20	710
Sand	30	740
Coal	5	745
Slate	65	810
Sand	20	830
Slate, some water	55	885
Salt sand, water	495	1380
Big lime	200	1580
Sand, Big Injun	62	1642
Slate shells	107	1749
Slate	306	2055
Sand, Berea Grit, to bottom, gas	13	2068

"13" casing, 28 feet; 10" casing, 105 feet; 8" casing, 787 feet; 6⅝" casing, 1389 feet; 5 3-16" casing, 1664 feet; gas well."

Jack Bryan Well Record (625A).

Located 3¼ miles southwest of Saint Albans, Jefferson district. Authority, Guffey & Galey. Elevation 715' A. T. B.

	Thickness Feet.	Total Feet.
Surface	24	24
Slate	126	150
Sand	45	195
Slate	15	210
Sand	30	240
Slate	25	265
Sand	135	400
Slate	10	410
Sand	100	510
Slate	5	515
Sand	115	630
Slate	40	670
Sand	50	720
Slate	70	790
Sand	20	810
Slate	20	830
Sand	20	850
Slate	20	870
Sand	510	1380
Big Lime	200	1580
Slate	20	1600
Sand, Big Injun	50	1650
Slate and shells	415	2065
Sand, Berea Grit	25	2090
Slate to bottom	3	2093

"10" casing, 29 feet; 8" casing, 185 feet; 6⅝" casing, 1385'; large quantity of salt water, 950'; little gas in Big Lime, 1460'; little gas in Big Injun, 1605'; little gas in Berea Grit, 2070'; well abandoned."

The above well begins about 345 feet under the Pittsburgh Coal horizon.

M. E. Yoder No. 1 Well Record (628).

Located at Tornado, Jefferson district. Authority, Duval Oil Company. Completed April, 1912. Elevation 618' A. T. L.

	Thickness Feet.	Total Feet.
Earth	30	30
Sand	30	60
Slate	10	70
Sand	30	100
Slate	20	120
Sand	30	150
Slate	20	170

	Thickness Feet.	Total Feet.
Sand	30	200
Slate	45	245
Sand	20	265
Slate	10	275
Sand	50	325
Slate	75	400
Sand	60	460
Coal	2	462
Slate and sand shells	138	600
Sand	40	640
Slate, some sand	150	790
Sand and slate	30	820
Salt sand, broken, water 890'	515	1335
Slate	15	1350
Lime	10	1360
Slate, soft	5	1365
Big Lime	235	1600
Sand	15	1615
Slate	22	1637
Sand, Big Injun	43	1680
Slate and shells	130	1810
Sand, Squaw	20	1830
Slate	250	2080
Black shale	15	2095
Sand, Berea Grit to bottom, oil	22	2117

10" casing, 30 feet; 8¼" casing, 270'; 6⅝" casing, 1380 feet; 5 3-16" casing, 1700 feet. Water at 80 feet; more water at 245 feet; top of salt sand 890 feet; water 890 feet; gas in Berea sand, 2108 feet; oil in bottom sand, 2119 feet, 5 to 20 barrels.

This well begins about 430 feet under the base of the Pittsburgh coal, and hence the coal at 460' is one of the Kanawha Series.

Crawford & Ashby No. 1 Well Record (626).

Located at Lewis station, mouth of Tacketts creek, Jefferson district. Authority, Coal River Oil & Gas Company. Completed July 13, 1906. Elevation 575' A. T. L.

	Thickness Feet.	Total Feet.
Quick sand and gravel	47	47
Lime and pink rock	103	150
Sand	60	210
Slate	5	215
Sand	45	260
Coal, very good	5	265
Sand	55	320
Coal, very good	5	325
Sand	65	390
Slate, black	5	395

	Thickness Feet.	Total Feet.
Sand	65	460
Coal, Coalburg	4	464
Sand	11	475
Sandy lime	10	485
Sand	10	495
Pink rock	5	500
Sand	10	510
Slate	40	550
Lime	30	580
Sand	10	590
Slate and shells	10	600
Sandy lime	30	630
Slate	20	650
Broken lime	160	810
Top Salt sand	60	870
Little break coal	2	872
Sand, salt water at 945'	120	992
Slate	18	1010
Sand	200	1210
Slate	45	1255
Red rock	10	1265
Lime	15	1280
Black lime	20	1300
Big Lime	205	1505
Slate	15	1520
Sand, Big Injun	50	1570
Shells and slate	170	1740
White slate	215	1955
Black slate	37	1992
Sand, Berea Grit	23	2015
Black lime	15	2030
Black slate	150	2180
White slate	200	2380
Black slate to bottom	195	2575

"10" casing, 47 feet; 8" casing, 510 feet; 6¼" casing, 1300 feet. Salt sand formation had water all the way through; first show of salt water at 945 feet; water from that on to 1300 feet. Top of Big Lime formation very hard and white all the way through; Big Injun sand very soft with about five barrels salt water per hour; Berea Grit sand very hard with a little show of dark oil. Drilling continued 560 feet below Berea Grit not finding Gordon or Fifth sand."

Prospective Oil and Gas Territory, Jefferson District.

It will be noted from the Structural Geological Map accompanying this report, that Jefferson district has not been thoroughly prospected, and that there remains a large acreage that looks favorable for oil near the center of the district, if the lower strata are not too hard or close-grained. The Saint

Albans syncline extends northward through the center of the district, giving favorable prospects for oil in the Berea sand along this trough. From the Crawford & Ashby well No. 1 (626) at Lewis to the J. M. Reynolds well (629) on Two and Three Quarter Mile creek 2.75 miles east of Saint Albans, the top of the Berea sand falls 102 feet in 3.5 miles, or about 30 feet to the mile; and from this point eastward the strata rise rapidly, until in the Huling well (639) on Davis creek, the top of the Berea sand has risen 201 feet above the Reynolds well, in 8.5 miles, south 30° east, or about 24 feet to the mile.

WASHINGTON DISTRICT.

Washington district is situated south of Jefferson district and is traversed on the western edge by the Saint Albans syncline.

Very little drilling for oil and gas has been done in this part of Kanawha county.

Pike Trowbridge No. 1 Well Record (632).

Located on Smith Creek, 1¾ miles east of Tornado P. O., Washington district. Authority, Guffey & Galey. Elevation 680' A. T. B.

	Thickness Feet.	Total Feet
Mud	20	20
Sand	155	175
Coal, Upper Freeport	3	178
Lime	22	200
Slate	25	225
Sand	150	375
Slate	25	400
Sand	80	480
Coal, Stockton-Lewiston	5	485
Sand	25	510
Slate	140	650
Lime	10	660
Slate	120	780
Lime shells	105	885
Coal, No. 2 Gas ?	3	888
Shells	42	930
Salt sand	230	1160
Slate	40	1200
Water sand	5	1205
Slate	55	1260
Sand	10	1270

	Thickness Feet.	Total Feet.
Slate	30	1300
Sand	138	1438
Lime, hard	2	1440
Gray sand, break	10	1450
Sand	40	1490
Black lime	20	1510
Big Lime	190	1700
Slate	15	1715
Sand, Big Injun	40	1755
Slate	10	1765
Sand, Squaw	10	1775
Gray slate	404	2179
Black slate	20	2199
Black sand, Berea	12	2211
Black shale to bottom	20	2231

"Water at 60 feet; second water, 140 feet; big water over top of hole, 1260 feet; gas at 100 feet in Big Lime—enough to run three boilers; small show of oil in first screw in Big Injun sand; salt water in second screw, 2 bailers an hour. At 2098' a small shell shows a black scum, a very light odor of gas; a small show of oil in top of Berea."

Another well was drilled in the extreme eastern part of the district near Ruth.

Dan Polly No. 1 Well Record (634).

Located on Trace Fork of Davis Creek near Ruth P. O., Washington district. Completed October, 1912. Authority, Annette Oil & Gas Company, Charleston, W. Va. Elevation 690' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	10	10
Sand and limestone	47	57
Coal, No. 5 Block	4	61
Slate	10	71
White clay	18	89
White sand	45	134
White slate	10	144
Coal, Stockton-Lewiston	2	146
White sand	74	220
Coal, Coalburg	4	224
Slate	10	234
Limestone, hard	70	314
Coal, Winifrede ?	7	321
Sand and lime	139	460
Black shale	10	470
Limestone and gas sand	55	525
Black shale	145	670
Gas sand	24	694
Black slate	5	699
White sand	30	729

	Thickness Feet.	Total Feet.
Limestone, hard	51	780
Black shale and shells	6	786
Salt sand	736	922
Black shale	4	926
White sand	24	950
Sand	12	962
White sand	158	1120
Black shale and slate	12	1132
White sand, hard	193	1325
Shale	3	1328
White sand and lime, Maxton?	50	1378
Slate and shale	60	1430
Little Lime	48	1484
Pencil Cave	4	1488
Big Lime, hard	152	1640
"Break," red rock	24	1664
Broken Big Injun	6	1670
Red rock	30	1700
Black shale	14	1714
Slate	346	2060
Shale and slate	60	2120
Hard lime shells	1	2121
Shale and slate	8	2129
Slate and soapstone	9	2138
Slate	32	2170
Gray slate and shells, Berea	11	2181
White slate	49	2230
Dark slate	22	2252
Slate	10	2262
Slate darker	158	2420
Hard shells	4	2424
Slate to bottom; steel line	50	2474

"Dry hole; well abandoned; 10" casing, 79 feet; 8¼" casing, 502 feet; 6½" casing, 1492 feet; water at 40 feet; water in Salt sand at 808 feet and 840 feet."

Prospective Oil and Gas Territory, Washington District.

Very little drilling for oil and gas has yet been done in Washington district, and practically the whole district remains uncondemned by the drill for oil and gas. A well drilled near Sproul was found dry in all the sands, while at Upper Fall, just east of the Washington-Jefferson district line, a small well, the Yoder oil well, (628) was found in the Berea sand.

In the Trowbridge well (632) in the northern part of the district, a small showing of oil was found in the Berea sand.

The geologic structure indicates that there may possibly

be a small pool north of Coal river in the western portion of the district, in the Berea sand, if this formation is regular.

ELK DISTRICT.

The rocky strata in Elk district are considerably warped and disturbed. The Milliken anticline passes in a northern direction through the entire western part of the district; the Jarrett syncline in a northern direction through the central part of the district and the great Warfield anticline dies down and disappears west of its center. The Coopers creek gas field, the Blue creek oil pool, and a portion of the Hackberry pool are in Elk district.

Early History.

No oil or gas of commercial value was found in Elk district until 1908, when the Lory gas well was drilled by the Elk River Oil & Gas Company, and gas was found in the Coopers Creek gas field. The latter part of 1911 oil was found in the Schwartz & Barth well No. 1, which subsequently led to the development of the Blue Creek pool. Salt wells were drilled at Bream (Big Chimney) in 1830-1840, and traces of oil were found in the shallow sands often destroying the value of the salt wells.

An interesting paper is recorded in the Kanawha county clerk's office in deed book "Y", pages 395-397, concerning the geology of Elk district from the mouth of Coopers creek (Bream) northwestward, a distance of about 6 miles to a point above the mouth of Blue creek.

It appears from these records that in 1864, just after the maximum development of the Burning Springs oil field in Wirt county, this State, eastern capitalists became convinced that oil would be found on Elk river right at the location of the present field, an expert named E. W. Evans having been employed by William Frazier and his associates of Philadelphia to make a report upon certain leases in which Frazier and others were interested known as the William H. Goddard leases extending along Elk river for a distance of about six miles between a small island near the mouth of Cooper creek

to an island just below the mouth of Blue creek, and extending back into the hills on the south side of the river along the waters of Pinch and Indian creeks.

Following the recordation of the leases is a report thereon signed by Evans in which he says that oil lands were in great demand in this territory and that there were four different companies trying to get leases; that oil had been struck in large quantities on the land owned by John Gunter as early as 1838, and that another well had been struck on the land of James S. Connell, one-half mile above the Gunter well in 1841; that there were several veins of oil struck in drilling the wells which were drilled to obtain salt water, and that one vein was struck at 275 feet which yielded a considerable quantity and had to be "tubed out", or "cased off", as we now express this kind of work.

Evans goes on further in his report to show that there were numerous oil and gas springs in this vicinity and on his map of the properties he indicates the "great spouting well of 1838 on the Gunter farm just above the mouth of Cooper creek on the north side of Elk, also the "Connell oil well of 1840", and several gas springs. He says that there is every evidence of an abundance of oil on Pinch and Indian creeks, and calls attention to the fact that this territory is situated "on a line running northeast and southwest and exactly on a straight line joining the celebrated Burning Springs on the Little Kanawha region and the other (Burning Springs) on the Great Kanawha" and states that along this line lie the celebrated oil wells on Cow Run, Bull Creek, Horseneck and Little Kanawha, these being the localities where oil was first produced in West Virginia about 1860-'65. This report is further substantiated by affidavits made by citizens living on Elk river concerning the presence of oil and gas in the salt wells in that region. One year later, this same geologist, E. W. Evans, was employed by the West Virginia and Ohio Petroleum Company of Cincinnati, Ohio, to make a report on the probable oil and gas territory on Elk river between Cooper and Blue creeks. The report is dated Charleston, West Virginia, February 20, 1865, and is now in the possession of Hon. J. F. Cork of that city. The Report is as follows:—

Report of E. W. Evans, Geologist.

"Having at your request examined three tracts of oil land situated on and near Elk river, I submit the following report:

"There are many facts which point to this part of the Great Kanawha Valley as one of the best oil regions in the world. Hitherto the largest quantities of petroleum have been found on the western slope of the Alleghanies in Pennsylvania and West Virginia. One of the most eminent living geologists, Dr. J. S. Newberry, assigns as one reason for this fact, that here the oil-bearing strata are much thicker than they are on the other side of the Ohio river. There is a well-known belt of oil lands not many miles in breadth extending along a line of marked geological disturbance from the neighborhood of Bull Creek and French Creek on the Ohio River, across Hughes River, Little Kanawha, near Burning Springs, thence across Upper Pocatalico and Elk River to Burning Springs on the Great Kanawha, nine miles above Charleston.

"All along this belt there are lines of fracture and dislocation running parallel to the general course of the Alleghanies. There is in general a marked anticlinal axis of upheaval, with synclinal axis lying a few miles to either side of it. Such uplifts and dislocation indicates numerous and large cavities in the rock beneath, and taken in connection with other signs, they are regarded as the most reliable indication of the existence of large quantities of petroleum.

"Prof. C. B. Andrews, in the American Journal of Science (Vol XXXII), calls attention to the fact that the best oil wells of Virginia are located along this line of disturbance, which he has traced from the Ohio River southward a distance of more than 40 miles. It is indeed true that wherever along this line wells have been bored for oil or for salt, oil has been found in good quantities.

"In an able treatise on the saliferous rock formation of the Ohio Valley by the late eminent naturalist, Dr. S. P. Hildreth, published in the Journal of Science for 1833, I find the statement that the salt wells on the waters of the Great Kanawha yielded petroleum more abundantly than those of the Muskingum region.

If, then, operating directly for petroleum the latter has been found a productive field, the former will be found more so. In the only two salt wells ever bored up Elk River, known as the Gunter and Connell wells, oil was found in large quantities; and one of these was among the most remarkable flowing wells of which there is any record.

"According to the same accurate authority the Burning Springs on the Great Kanawha is right upon the anticlinal axis of the upheavel, the rocks dipping to the northwest from this point at the rate of 500 feet to the mile and to the southeast at a somewhat less rate. I have observed by tracing veins of coal that where this axis crosses Elk River near Queen Shoals, the dip to the northwest side, is less than a hundred feet to the mile.

"The geological position of the rocks of this region is such that wells will penetrate the lower coal measures which have always been found more productive of oil than the upper. The rocks are the same kind as those which characterize other good oil districts, deep layers of sandstone stratified with shales, seams of coal and iron ore and occasionally a thin layer of limestone. The surface is rough and broken, the hills high and precipitous, but very much intersected with creeks, runs and ravines. On and around your three tracts

there are numerous mineral springs (generally salt, sulphur and chalybeate), on all of which a scum of petroleum appears, accompanied with bubbling up of carbonate of hydrogen gas. This, when connected with mineral springs, is good evidence of deep oil. It is not seen here on ordinary springs of pure water, whose source is near the surface; it comes up through cracks and fissures in the strata from depths where the water has gathered its various mineral contents. The high temperature of these oil springs as compared with springs of pure water is another fact indicating a deep source. This is a very important point, for experience has proven that supplies of oil found near the surface are the least durable. On Elk River, oil was struck in the salt wells at a depth of nearly 300 feet. The white calcareous and rock full of cavities and fissures, in which, according to Dr. Hildreth (Journal of Science 1833), used to be struck near the Burning Springs at about the same depth, is found 300 to 500 feet lower on Elk and doubtless will be found proportionately more productive when reached.

"Your three tracts all lie upon the upheavel belt, not far from the main axis. They are located at three very favorable points, considered with reference to indications of oil. The lands in the vicinity of each are in very great demand by oil companies. Blue Creek Island in Elk River, 12 miles above Charleston and 3 miles above the Gunter & Connell wells, contains about 6 acres of fine bottom ground. Within a quarter of a mile from this island, near the mouth of Blue Creek, there is a remarkable gas spring."

Lory No. 1 Well Record (757).

Located on Coopers Creek at mouth of Four Mile Fork, ¾ mile northeast of Mink, Elk district. Authority, Coal River Oil & Gas Company. Completed December 8, 1908. Elevation 638' L.

	Thickness Feet.	Total Feet.
Sand and gravel	20	20
Slate	160	180
Coal, No. 5 Block	4	184
Slate	31	215
Sand	30	245
Coal, Stockton-Lewiston	3	248
Slate	32	280
Coal, Coalburg	6	286
Slate	24	310
Sand	30	340
Slate	20	360
Sand	40	400
Slate	20	420
Sand	60	480
Slate	60	540
Sand	20	560
Slate	75	635
Sand, Salt	415	1050
Slate	30	1080
Sand	80	1160
Slate	30	1190

	Thickness Feet.	Total Feet.
Sand	100	1290
Black lime	10	1300
Slate (Pencil Cave)	10	1310
Big Lime	130	1440
Slate	10	1450
Big Injun Sand, gas	25	1475

"10" casing, 20 feet; 8¼" casing, 180 feet; 6⅝" casing, and 6¼" casing, 1310 feet; 5⅝" casing and 4⅞" casing, 1310 feet. Gas, 1454 feet, about 2,000,000 cu. ft."

This well starts 520 feet under the base of the Pittsburgh sandstone, and the coal encountered at 180 feet is possibly the **No. 5 Block coal.**

Nick Barth No. 1 Well Record (763).

Located on Three Mile Fork of Coopers Creek, 1¾ miles northwest of Copenhaver P. O., Elk district; well completed Jan. 29, 1910. Authority, Dr. M. Wehrle. Elevation, 725' A. T. B.

	Thickness Feet.	Total Feet.
Gravel, brown	10	10
Sand, white	90	100
Slate, blue	20	120
Coal, No. 5 Block	4	124
Sand, white	176	300
Lime, white	15	315
Slate, white	10	325
Coal, Block, Stockton-Lewiston	8	333
Sandy lime, gray	47	380
Sand, gray	40	420
Slate, white	10	430
Lime, white	15	445
Sand, white	35	480
Slate, black	20	500
Sand, white	40	540
Slate, blue	160	700
Sand, gray	5	705
Sand, white	95	800
Slate, blue	15	815
Sand, white	291	1106
Slate	7	1113
Sandy lime, gray	12	1125
Sand, white	190	1315
Sand, broken	15	1330
Sand, brown	15	1345
Little Lime, black	31	1376
Pencil cave, black	6	1382
Big Lime	151	1533
Big Injun, white, gas	12	1545

"Showing of gas 885'-895'. oil 895'-910'; water, 920'; hole full of water, 1020'; gas in Big Injun, 1533'-1545', 3,000,000 cu. ft. per day."

Dr. M. Wehrle No. 1 Well Record (764).

Located on Coopers Creek, 2 miles northwest of Copenhaver, Elk district. Completed March 3, 1910. Authority, Dr. M. Wehrle. Elevation, 628' L.

	Thickness Feet.	Total Feet.
Rock, red	17	17
Gravel, brown	11	28
Slate, black	32	60
Sand, white	20	80
Slate, black	20	100
Sand, brown	140	240
Stone, black	15	255
Coal, Block, Stockton-Lewiston	3	258
Slate, white	42	300
Sand, gray	40	340
Slate, black	40	380
Sand, white	90	470
Slate, white	50	520
Lime, white	40	560
Slate, black	60	620
Sand, white	40	660
Slate, black	40	700
Sand, white	558	1258
Little lime, black	20	1278
Slate, black	14	1292
Pencil Cave	8	1300
Big Lime, white	156	1456
Sand, Big Injun, white	64	1520
Slate and shells, white	435	1955
Shale, brown	5	1960
Slate, shells	2	1962
Slate, shells to bottom	48	2010

"Gas and showing of oil at 705'; gas at 860'; small showing of gas in Big Injun; no Berea Grit found. Dry hole, and well abandoned."

A. J. Jones No. 1 Well Record (715).

Located on waters of Cooper Creek, 1 mile southwest of Copenhavers P. O., Elk district. Completed March 14, 1912. Authority, Dr. M. Wehrle. Elevation, 700' A. T. B.

	Thickness Feet.	Total Feet.
Clay, yellow	30	30
Sand, white	50	80
Slate, black	20	100
Slate, white	90	190
Coal, No. 5 Block	6	196
Slate, white	154	350
Sand, white	50	400
Slate, black	50	450
Sand, white	100	550

	Thickness Feet.	Total Feet.
Slate, black	100	650
Slate, white	50	700
Lime, white	75	775
Sand, gray	35	810
Slate, black	15	825
Sand, white	175	1000
Slate, black	10	1010
Sand, white	270	1280
Slate, block	20	1300
Sand, white	60	1360
Lime, black	51	1411
Big Lime, white	143	1554
Sand, Big Injun, gray	26	1580

"Four bailers water at 70 feet; 6 bailers of water at 200 feet; hole full of water at 880 feet; 10 bailers of water at 1564 feet; dry hole, and well abandoned."

Grant Copenhaver No. 1 Well Record (734).

Located on Cooper Creek, 2 miles northwest of Copenhaver P. O.. Elk district. Completed Feb. 6, 1911. Authority, United Fuel Gas Co. Elevation, 897' A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	16	16
Sand	5	21
Red rock.	24	45
Sand	20	65
Red rock	167	232
Sand	43	275
Black slate	91	366
Lime	20	386
Sand	24	410
Coal, No. 5 Block	5	415
Lime sand	105	520
Black slate	25	545
White slate	20	565
Sand	58	623
Coal	3	626
Black slate	32	658
Lime	67	725
Slate	7	732
Lime shells	68	800
Black slate	75	875
Lime	45	920
Black slate	15	935
Lime shells	40	975
Slate	5	980
Lime	31	1011
Slate	6	1017
Sand, 1st Salt	253	1270
Coal, Sewell horizon ?	5	1275

	Thickness Feet.	Total Feet.
Slate	40	1315
Sand, 2d Salt	198	1513
Little Lime	34	1547
Pencil cave	9	1556
Big Lime	155	1711
Big Injun sand, gas	12	1723

"Gas well; hole full of water at 1060'; calculated volume 2.166,000 cu. ft. per day."

In 1891 E. M. Hukill & Company drilled a well on the Lewis Hammack farm on Little Sandy creek, near the mouth of Wills creek, but the well proving dry was abandoned. The following is the record of the well:

Lewis Hammack No. 1 Well Record (831).

Located on Little Sandy Creek, 1¼ miles north of Jarrett, Elk district. Authority, Prof. John F. Carll. Elevation, 660' A. T. B.

	Thickness Feet.	Total Feet.
Drive pipe	60	60
Slate	130	190
Sandstone, gray	360	550
Slate and shells	175	725
Slate	50	775
Sandstone, white	25	800
Slate and shells	125	925
Sandstone, salt sand	389	1314
Slate and shells	71	1385
Sandstone, white, salt water	55	1440
Limestone	30	1470
Slate	15	1485
Lime	140	1625
Slate	125	1750
Soft slate to bottom	252	2002

"Cased to 1455 feet; little gas and water in Big Lime; dry hole, and well abandoned."

C. L. Stewart No. 1 Well Record (594).

Located in Elk district on Buckner Branch of Little Sandy Creek, 3 miles northeast of Hunt. Authority, United Fuel Gas Company. Completed Sept. 30, 1907. Elevation, 737' A. T. B.

	Thickness Feet.	Total Feet.
Drift	13	13
Red rock	207	220
Shale	160	380

	Thickness Feet.	Total Feet.
Sand	172	552
Slate	23	575
Sand	125	700
Slate	240	940
Broken sand	120	1060
Salt sand	424	1484
Broken sand	16	1500
Sand, Maxton	42	1542
Little Lime	43	1585
Pencil cave	7	1592
Big Lime	133	1725
Big Injun sand	46	1771
Slate to bottom	4	1775

"Flow of water, 1270'; show of gas, 1160'."

C. Summers No. 2 Well Record (499).

Located on Buckner Branch in Elk district, 3 miles northeast of Hunt P. O. Completed Nov. 20, 1912. Authority, United Fuel Gas Company. Elevation, 608' B.

	Thickness Feet.	Total Feet.
Dirt and gravel	57	57
Unrecorded	303	360
Coal	2	362
Unrecorded	88	450
Sand	70	520
Shale	125	645
Sand	55	700
Slate	10	710
Salt sand	500	1210
Slate	5	1215
Lime	40	1255
Slate	15	1270
Sand, Maxton	78	1348
"Break"	2	1350
Little Lime	40	1390
Pencil cave	5	1395
Shells	5	1400
Big Lime	170	1570
Slate	4	1574
Sand, Big Injun	25	1599
Slate and shells	62	1661
Sand, Squaw	20	1681
"Break"	5	1686
Stray sand	18	1704
Slate and shells to bottom	17	1721

"Slight show of gas at 1540'; light showing of oil and gas at 1669'; dry hole, and well abandoned."

Schwartz & Barth No. 1 Well Record (202).

Located in Elk district, one-half mile southeast of Blue Creek P. O. Authority, Ohio Fuel Oil Company. Completed Sept. 20, 1911. Elevation, 785' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Red rock	84	100
Sand	270	370
Coal	6	376
Sand	24	400
Slate	25	425
Sand	75	500
Slate	25	525
Sand	155	680
Slate	20	700
Sand	100	800
Slate	50	850
Sand	150	1000
Slate	50	1050
Salt sand	400	1450
Slate	50	1500
Red rock	20	1520
Slate	62	1582
Sand	15	1597
Slate	62	1659
Pencil cave	5	1664
Big Lime	160	1824
Sand, Big Injun	18	1842
Black slate	10	1852
Red rock	20	1872
Slate	57	1929
Sand, very poor ..... 8 Sand, very good .....13 } Squaw	21	1950
Total depth		1951

"Oil well. Show of oil at 1909'."

This was the first well drilled in the Blue Creek Oil field, and marks the beginning of that development.

The B. B. Hall No. 1 Well Record (339).

Located on Blue Creek Island at mouth of Blue Creek, Elk district. Completed March 20, 1912. Authority, Ohio Fuel Gas Company. Elevation, 612' L.

	Thickness Feet.	Total Feet.
Unrecorded	283	283
Sand	27	310
Lime	55	365
Slate	35	400

	Thickness Feet.	Total Feet.
Lime shells	35	435
Sand	100	535
Slate	15	550
Sand	50	600
Slate	20	620
Sand	30	650
Slate	35	685
Sand	20	705
Slate	58	763
Sand	73	836
Slate	2	838
Salt sand	366	1204
Cave	11	1215
Lime	25	1240
Red rock	25	1265
Lime	30	1295
Red rock	15	1310
Slate	15	1325
Sand, Maxton	25	1350
Little Lime	20	1370
Slate	35	1405
Lime shells	15	1420
Pencil cave	4	1424
Big Lime	160	1584
Sand, Keener	20	1604
Slate and lime shells	74	1678
Black sand	11	1689
Black slate	18	1707
Oil sand, Squaw	13	1720
Slate to bottom	1	1721

"Oil well; oil at 1707' to 1715'; bailer of water per hour in 'Keener' sand."

This well is located on the island where Geologist E. W. Evans in his report in 1865, stated was a good place to locate a well.

E. T. Cart No. 1 Well Record (195).

Located in Elk district on Buffalo Lick Branch of Elk River, one mile south of Alum Creek station. Completed June 7, 1912. Authority, Ohio Fuel Oil Company. Elevation, 621' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Lime	48	64
Slate	70	134
Sand	200	334
Slate and shells	60	394
Sand	66	460

			Thickness Feet.	Total Feet.
Slate			100	560
Sand			80	640
Salt sand			635	1275
Slate			120	1395
Little Lime			30	1425
Slate and shells			27	1452
Big Lime			150	1602
Red rock			15	1617
Slate and shells			63	1680
Lime and sand			18	1698
Oil sand	6			
Shale	8	Squaw sand	19	1717
Oil sand	5			
Slate to bottom			3	1720

"Oil well; hole full of water at 334'; gas at 1698'; show of oil at 1704'."

S. S. Moore No. 9 Well Record (117).

Located in Elk district, one-half mile southeast of Jarrett's Ford P. O. Completed October 8, 1912. Authority, Ohio Fuel Gas Company. Elevation, 805' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Slate	84	100
Sand	80	180
Coal	5	185
Sand	135	320
Coal	5	325
Sand	145	470
Coal	5	475
Slate	5	480
Coal	10 ?	490
Sand	335	825
Black slate	45	870
Lime	15	885
Slate and shells	30	915
Dark slate	10	925
Salt sand	485	1410
Slate	2	1412
Sand	8	1420
Red rock	15	1435
Lime	30	1465
Coal	2	1467
Sand and shells	28	1495
Sand	75	1570
Little Lime	25	1595
Slate	5	1600
Lime	8	1608
Slate	7	1615

	Thickness Feet.	Total Feet.
Lime	10	1625
Slate	2	1627
Big Lime	143	1770
Slate and shells	20	1790
Red rock	10	1800
Slate and shells	65	1865
Oil sand, Squaw	5	1870
Lime	11	1881
Second pay	7	1888

This driller evidently desired to establish a record for coal since he reports 2 feet of it even below the Mauch Chunk Red shale. The record is evidently unreliable so far as coal is concerned. (I. C. W.)

S. R. Hall No. 1 Well Record (393).

Located in Elk district on south side of Blue Creek 1.5 miles southeast of Blue Creek P. O. Completed Feb. 11, 1912. Authority, Ohio Fuel Oil Company. Elevation, 878'.

	Thickness Feet.	Total Feet.
Conductor	14	14
Sand	56	70
Slate and shells	115	185
Sand	8	193
Slate	55	248
Coal	6	254
Slate	21	275
Sand	50	325
Slate and sand	62	387
Sand	120	507
Slate	79	586
Sand	49	635
Slate	55	690
Sand	53	743
Slate and shells	45	788
Sandy lime	84	872
Salt sand	458	1330
Slate	17	1347
Lime	38	1385
Slate and sand	38	1423
Red rock	11	1434
Lime	4	1438
Red rock	7	1445
Lime	30	1475
Slate	13	1488
Lime	24	1512
Slate	10	1522
Lime	3	1525
Pencil cave	8	1533

	Thickness Feet.	Total Feet.
Big Lime	137	1670
Sand	30	1700
Black slate	44	1744
Red rock	8	1752
Sand	10	1762
Slate	5	1767
Lime	11	1778
Oil sand	17	1795
Slate	95	1890
Sand	10	1900
Sand	55	1955
Unrecorded to bottom	25	1980

The above well is located at the eastern limits of the Blue Creek oil field, and is a light well.

M. & N. J. Vancamp No. 1 Well Record (828).

Located in Elk district on Three Mile Fork of Blue Creek, 2.2 miles southeast of Blue Creek P. O. Completed April 1, 1911. Authority, United Fuel Gas Company. Elevation, 935' B. T. L.

	Thickness Feet.	Total Feet.
Gray slate	100	100
Sand	100	200
Slate	25	225
Sand	75	300
Coal	5	305
Sand	50	355
Slate	95	450
Lime	25	475
Sand	25	500
Slate	50	550
Sand	20	570
Black slate	180	750
Sand	40	790
Black slate	110	900
Salt sand	300	1200
Slate	75	1275
Sand	150	1425
Slate	100	1525
Sand	25	1550
Red rock	20	1570
Little Lime	30	1600
Pencil cave	7	1607
Red rock	5	1612
Big Lime	175	1787
Big Injun sand	5	1792
Slate	150	1942
Sand, Squaw	80	2022
Slate to bottom	278	2300

"Small oil well; pumped 3 bbls.; little gas in lime; hole full of water at 1050'; oil from 1942'-1945'."

This well is located about one mile east of the eastern limits of the Blue Creek oil field.

Henry Gillispie No. 1 Well Record (356).

Located in Elk district on Pinch Creek, 1.5 miles east of Pinchton P. O. Completed Jan. 2, 1913. Authority, United Fuel Gas Company. Elevation, 815' B.

	Thickness Feet.	Total Feet.
Unrecorded	12	12
Lime	28	40
Slate	20	60
Sand	50	110
Slate	65	175
Sand	51	226
Coal, No. 5 Block	5	231
Unrecorded	100	331
Sand	69	400
Slate	50	450
Sand	30	480
Slate	40	520
Lime	25	545
Slate	30	575
Sand	45	620
Slate	40	660
Sand	40	700
Slate	20	720
Sand	40	760
Slate	140	900
Salt sand	510	1410
Slate	10	1420
Sand, Maxton	65	1485
Slate	15	1500
Little Lime	32	1532
Slate	8	1540
Lime	5	1545
Slate	10	1555
Lime	8	1563
Slate	9	1572
Big Lime	153	1725
Slate	85	1810
Sand, Big Injun	12	1822
Slate	8	1830
Sand, Squaw	49	1879
Unrecorded to bottom	109	1987

"Oil well; first gas 1885'; second gas 1907'; first oil 1923'; little salt water 1960'; second oil, 1971'."

Walter Morris No. 1 Well Record (784).

Located in Elk district, on Turkey Fork of Indian Creek. Completed Dec. 25, 1912. Authority, United Fuel Gas Company. Elevation, 900' A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	16	16
Slate	64	80
Sand	40	120
Slate	40	160
Sand	90	250
Coal, Stockton-Lewiston	4	254
Slate	21	275
Sand	25	300
Slate	40	340
Sand	60	400
Slate	50	450
Sand	50	500
Slate	125	625
Sand	50	675
Lime and shells	25	700
Salt sand	240	940
Slate	5	945
Coal	4	949
Slate	4	953
Second Salt sand	267	1220
Slate	10	1230
Sand	90	1320
Slate	8	1328
Red rock	12	1340
Slate	8	1348
Sand, Maxton	32	1380
Little Lime	45	1425
Slate break	8	1433
Lime	10	1443
Pencil cave	4	1447
Big Lime	158	1605
Slate	90	1695
Sand, Squaw	7	1702
Slate	15	1717
Sand, Weir	25	1742
Slate to bottom	70	1812

"Oil well; gas 1504', 1569', 1700; oil 1767'-1795'; water at 280', 750' 820'."

Thumm Heirs No. 6 Well Record (99).

Located in Elk district on Pinch Creek, one-half mile east of Pinchton. Completed July 10, 1912. Authority, Ohio Fuel Oil Company. Elevation, 688' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Sand	180	196

	Thickness Feet.	Total Feet.
Coal, Stockton	3	199
Black lime	24	223
Sand	47	270
Slate	15	285
Coal, Winifrede ?	3	288
Lime	12	300
Slate and shells	20	320
Sand	40	360
Slate and lime	25	385
Sand	40	425
Limestone	5	430
Coal, No. 2 Gas ?	3	433
Slate	12	445
Sand	70	515
Slate	20	535
Sand	45	580
Slate	20	600
Sand	40	640
Slate and shells	22	662
Sand	48	710
Slate	30	740
Black lime	50	790
Slate	20	810
Salt sand	505	1315
Slate	8	1323
Red rock	5	1328
Limestone	62	1390
Soft slate	5	1395
Sand, Maxton	63	1458
Little Lime	25	1483
Slate	2	1485
Lime	3	1488
Slate	3	1491
Lime	21	1512
Pencil cave	7	1519
Big Lime	146	1665
Black lime	10	1675
Red rock	10	1685
Slate and shells	70	1755
Oil sand	13	1768
Shale to bottom	3	1771

"Oil well; hole full of water at 950 feet."

Jane O. Moles No. 1 Well Record (155).

Located in Elk district, 1¾ miles southwest of Blue Creek P. O. Completed April 27, 1912. Authority, South Penn Oil Company. Elevation, 1007' L.

	Thickness Feet.	Total Feet.
Unrecorded	1129	1129
Salt sand	472	1601
Unrecorded	36	1637

	Thickness Feet.	Total Feet.
Red rock	3	1640
Lime	135	1775
Slate	3	1778
Little Lime	17	1795
Pencil cave	20	1815
Big Lime	160	1975
Slate and shells	96	2071
Sand, Squaw	13	2084

"Oil well; water at 700', 1199'; hole full of water at 1240'."

This well is located at the western edge of the Blue Creek oil field.

Jackson Meyers No. 1 Well Record (166).

Located in Elk district, 1.8 miles southwest of Blue Creek P. O. and about three-fourths mile south of the Jane O. Moles well No. 1, (155'). Completed April 2, 1912. Authority, South Penn Oil Company. Elevation, 1035' B.

	Thickness Feet.	Total Feet.
Unrecorded	395	395
Sand	130	525
Unrecorded	425	950
Sand	47	997
Unrecorded	93	1090
Salt sand	514	1604
Unrecorded	31	1635
Sand, Maxton	12	1647
Lime and slate	13	1660
Red rock	7	1667
Lime	13	1680
Slate	7	1687
Lime and red rock	13	1700
Little Lime	20	1720
Slate	15	1735
Lime	23	1758
Pencil cave	7	1765
Big Lime	183	1948
Sand, Big Injun	7	1955
Slate and shells	71	2026
Sand, Squaw	21	2047
Slate and shells	91	2138
Sand, Weir	62	2200
Total depth	...	2213

"Oil well; water at 1190'; oil and gas at 2037'; show of oil at 2140'."

This well is located on the eastern edge of the Blue Creek oil field, and is a light well.

R. E. McCabe No. 1 Well Record (175).

Located in Elk district, 1.5 miles south of Blue Creek P. O. Completed March 22, 1912. Authority, South Penn Oil Company. Elevation, 744' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Unrecorded	44	60
Sand	630	690
Unrecorded	140	830
Salt sand	520	1350
Red rock	15	1365
Lime	10	1375
Slate	25	1400
Sand, Maxton	65	1465
Little Lime	40	1505
Pencil cave	3	1508
Lime	4	1512
Pencil cave	6	1518
Big Lime	150	1668
Sand, Big Injun	10	1678
Red rock	18	1696
Slate and shells	60	1756
Sand, Squaw	31	1787
Slate and shells	86	1873
Sand, Weir	67	1940
Total depth	...	1943

"Oil well; water at 865'; hole full of water at 895'; gas and oil at 1765'."

This well is located in the eastern edge of the Blue Creek oil field, and is a light pumper.

J. H. Copenhaver No. 2 Well Record (252).

Located in Elk district one-fourth mile east of Blue Creek P. O. Completed June 23, 1912. Authority, Ohio Fuel Oil Company. Elevation, 596' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Sand	64	80
Slate and shells	180	260
Sand	100	360
Slate and shells	220	580
Sand	45	625
Black lime	55	680
Sand	20	700
Black lime	40	740
Salt sand	450	1190
Red rock	50	1240

	Thickness Feet.	Total Feet.
Slate	8	1324
Lime shells	76	1316
Little Lime	27	1351
Pencil Cave	5	1356
Lime shells	4	1360
Slate	4	1364
White lime	21	1385
Slate	4	1389
Big Lime	120	1509
Sand, Keener	25	1534
Slate and shells	79	1613
Black lime	20	1633
Slate	7	1640
Hard shells	2	1642
Oil sand, Squaw to bottom	17	1659

"Oil well; water at 825', first oil at 1652'; well flowed."

This well is located in the center of the Blue Creek oil field.

West of Pinchton, several wells have been drilled on the north side of Elk river, but the wells are generally light pumpers.

E. B. Slack No. 3 Well Record (2).

Located in Elk district, on north side, one-half mile southwest from Pinchton P. O. Completed Nov. 5, 1912. Authority, Ohio Fuel Oil Company. Elevation, 617' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Slate and shells	714	730
Salt sand	540	1270
"Break"	20	1290
Sand, Maxton	45	1335
Little Lime	30	1365
Pencil Cave	22	1387
Big Lime	163	1550
Sand, Big Injun	32	1582
Red rock	23	1605
Slate and shells	46	1651
Sand, oil and gas, Squaw	7	1658
Slate	5	1663
Sand	4	1667
Slate to bottom	3	1670

"Oil well, light pumper; water at 780'."

J. S. Newhouse No. 4 Well Record (448).

Located in Elk district, one-half mile south of Walgrove. Completed August 16, 1912. Authority, United Fuel Gas Company. Elevation, 957' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Clay	4	20
Broken lime	30	50
Sand	50	100
Red rock	50	150
Slate	25	175
Red rock	40	215
Slate	65	280
Red rock	30	310
Lime	40	350
Sand	160	510
Coal, Stockton-Lewiston	7	517
Lime	93	610
Coal, Coalburg, or Winifrede	5	615
Sand	125	740
Lime	100	840
Slate	60	900
Lime	70	970
Sand	50	1020
Lime	130	1150
Sand	400	1550
Slate	30	1580
Red rock	20	1600
Sand	50	1650
Break	5	1655
Sand, Maxton	26	1681
Pencil Cave	6	1687
Lime	33	1720
Break	10	1730
Pencil Cave	8	1738
Big Lime	120	1858
Sand, Big Injun	112	1970
Slate	48	2018
Sand	2	2020
Oil sand, Squaw, productive	12	2032

T. E. Melton No. 1 Well Record (343).

Located in Elk district on north side of Elk River, three-fourths mile southwest of Blue Creek P. O. Completed Jan. 13, 1912. Authority, South Penn Oil Company. Elevation, 617' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Sand and gravel	44	60
Slate, lime and shells	402	462
Slate and shells	118	580

	Thickness Feet.	Total Feet.
Sand	45	625
Unrecorded	155	780
Salt sand	420	1200
Lime	115	1315
Sand, Maxton	35	1350
Lime and slate	35	1385
Little Lime	30	1415
Pencil Cave	5	1420
Big Lime	150	1570
Sand, Big Injun	53	1623
Slate	7	1630
Red rock	6	1636
Black slate	89	1725
Sand, Squaw, oil	12	1737
Slate to bottom	3	1740

"Oil well; water at 870'; hole full of water at 880'. Production for first 24 hours from Squaw sand, 81 barrels, after which it settled down to a light pumper."

This well is located on the western edge of the Blue Creek oil field.

J. S. Newhouse No. 1 Well Record (446).

Located at Walgrove in Elk district. Completed May 4, 1912. Authority, Ohio Fuel Oil Company. Elevation, 683' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Unrecorded	204	220
Coal, Stockton-Lewiston	4	224
White sand	180	404
Lime and sand	126	530
Slate	60	590
Sand	40	630
Slate and shells	70	700
Sand	60	760
Slate and shells	110	870
Salt sand	410	1280
Black slate	6	1286
White sand	14	1300
Red rock	25	1325
Lime shells	15	1340
White slate	10	1350
Pink slate	30	1380
Black slate	20	1400
Little Lime	28	1428
White slate	2	1430
Lime shells	20	1450
Pencil cave	16	1466

	Thickness Feet.	Total Feet.
Big Lime	72	1538
Big Injun sand	67	1605
Black lime	35	1640
Slate and shells	101	1741
Black slate	12	1753
Oil sand, Squaw, oil	10	1763
Black lime to bottom	6	1769

"Oil well. Gas in Salt sand, 910'; water in Salt sand, 915'; pay from 1753' to 1760'."

The Blue Creek oil field crosses Elk river just west of Walgrove in Elk district, and productive oil and gas wells are found on the north side of the river at that point.

Jno. E. Hayes No. 1 Well Record (426).

Located in Elk district, one-fourth mile northeast of Walgrove. Completed July 16, 1912. Authority, United Fuel Gas Company. Elevation, 622' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Loose sand and gravel	42	58
Sand	87	145
Coal	3	148
Sand	27	175
Unrecorded	635	810
Salt sand	390	1200
Unrecorded	10	1210
Red rock	15	1225
Slate and shells	85	1310
Sand, Maxton	30	1340
Slate	10	1350
Little Lime	35	1385
Slate	7	1392
Red rock	5	1397
Pencil Cave	5	1402
Big Lime	138	1540
Sand, Big Injun	40	1580
Slate and shells	93	1673
Sand, Squaw, oil	22	1695

"Oil well; gas at 1470'; oil and gas at 1675'."

The center of the Blue Creek oil field as now developed, July 1, 1913, extends in a N 42° 30' E course through Elk district for a distance of nearly 6 miles, from a point one-half mile south of the mouth of Indian creek at Walgrove, where it

crosses the Elk-Big Sandy district line, and continues in practically the same course for three miles more through Big Sandy district. Its width is not more than one mile, and at some points not much more than one-half mile.

The records of some of the wells in the pool in Elk district have been given on preceding pages of this volume, and more records of wells in Big Sandy district will be given on succeeding pages.

About one mile east of Villa, on Mill creek, several gas wells have been developed. A few of these records will now be given.

S. S. Staunton No. 1 Well Record (488).

Located in Elk district at mouth of Right Fork of Mill Creek, three-fourths mile east of Villa P. O. Completed, 1912. Authority, Navajo Gas Company. Elevation, 800' B.

	Thickness Feet.	Total Feet.
Unrecorded	658	658
Salt sand	642	1300
Red rock	25	1325
Pencil Cave	3	1328
Little Lime	79	1407
Pencil Cave	3	1410
Unrecorded	30	1440
Big Lime	145	1585
Red rock	40	1625
Unrecorded	25	1650
Sand, Big Injun	90	1740
Black slate	25	1765
Sand, Weir, Squaw	51	1816
Lime, shells	94	1910
Unrecorded	12	1922
Slate to bottom	18	1940

"First show of gas in sand at 1670'; big show of gas at 1734'; good show of oil at 1794'; gas well."

S. S. Staunton No. 3 Well Record (491).

Located in Elk district on Mill Creek, 2 miles east of Villa. Completed, 1912. Authority, Navajo Gas Company. Elevation, 880' B.

	Thickness Feet.	Total Feet.
Unrecorded	20	20
Slate	20	40
Sand	30	70
Slate	30	100

	Thickness Feet.	Total Feet.
Sand	15	115
Coal, Stockton-Lewiston	5	120
Lime	20	140
Slate	20	160
Sand	20	180
Lime	20	200
Shells	45	245
Sand	55	300
Slate	5	305
Sand	35	340
Shells	110	450
Sand	50	500
Slate	15	515
Coal, No. 2 Gas	5	520
Sand	100	620
Slate	10	630
Lime shells	55	685
Salt sand	300	985
Slate	5	990
Second Salt sand	240	1230
Slate, cave	5	1235
Shells	25	1260
Sand	60	1320
Shells	30	1350
Red rock	10	1360
Lime	25	1385
Slate	15	1400
Little Lime	40	1440
Slate	5	1445
Shells	5	1450
Pencil Cave	5	1455
Big Lime, gas at 1535'	157	1612
Sand, Big Injun	13	1625
Red sand	10	1635
Red rock	25	1660
Slate and shells	40	1700
Sand, Squaw to bottom	63	1763

"First gas at 1718'; showing gas all through the Squaw sand. A little gas at 360 feet, and also at 640 feet. Water at 215'; hole full of water at 795'; gas in Big Lime at 1535'; little oil at 765'."

S. S. Staunton No. 6 Well Record (492).

Located in Elk district on Mill Creek, 2 miles east of Villa P. O. Completed Sept. 6, 1912. Authority, Navajo Oil Company. Elevation, 890' B.

	Thickness Feet.	Total Feet.
Conductor	15	15
Sand	30	45
Unrecorded	20	65
Coal, No. 5 Block Coal	2	67

	Thickness Feet.	Total Feet.
Sand	33	100
Unrecorded	10	110
Sand	35	145
Unrecorded	42	187
Coal, Stockton-Lewiston	3	190
Unrecorded	18	208
Coal, Coalburg	4	212
Sand	128	340
Unrecorded	130	470
Sand	38	508
Unrecorded	21	529
Sand	41	570
Unrecorded	20	590
Sand	42	632
Unrecorded	34	666
Lime	34	700
Salt sand	486	1186
Unrecorded	20	1206
Unrecorded	60	1266
Little Lime	64	1330
Unrecorded	16	1346
Red rock	26	1372
Lime	26	1398
Unrecorded	14	1412
Little Lime	44	1456
Pencil Cave	9	1465
Big Lime	151	1616
Big Injun sand	34	1650
Unrecorded	16	1666
Big Injun sand, gas 1702'-18' and 1752'	145	1811
Unrecorded to bottom	14	1825

"Gas well; little gas, 765'; water, 780'; hole full of water, 920'; first pay, 1702'-1718'; second pay, 1752'."

S. S. Staunton No. 7 Well Record (494).

Located in Elk district on Right Fork of Mill Creek, 1.5 miles southeast of Villa. Completed April, 1913. Authority, Navajo Oil Company. Elevation 870' B.

	Thickness Feet.	Total Feet.
Conductor	15	15
Sand	57	72
Coal, No. 5 Block	3	75
Unrecorded	10	85
Sand	42	127
Unrecorded	7	134
Coal, Stockton-Lewiston	3	137
Unrecorded	51	188
Coal, Coalburg	3	191
Unrecorded	11	202
Coal, Winifrede	4	206
Unrecorded	244	450

	Thickness Feet.	Total Feet.
Sand	72	522
Unrecorded	23	545
Sand	41	586
Unrecorded	9	595
Lime	17	612
Unrecorded	23	635
Salt sand	550	1185
Lime	55	1240
Lime	68	1308
Red rock	27	1335
Lime	29	1364
Unrecorded	16	1380
Little Lime	51	1431
Pencil Cave	9	1440
Big Lime	156	1596
First Big Injun (Keener)	6	1602
Red rock	38	1640
Unrecorded	52	1692
Second Big Injun	22	1714
Black sand, broken	121	1835
Black slate	205	2040
Coffee shale	34	2074
Broken lime	22	2096
Black slate	172	2268
Blue shale	72	2340
Pink shale	6	2346
Broken sand, Berea (?)	32	2378
Black slate	27	2405
Broken sand	21	2426
Black slate	51	2477
Blue shale	29	2506
Shale	16	2522
Blue slate	59	2581
Caving sand	12	2593
Light slate	37	2630
Slate	15	2645
Black slate	20	2665
Blue slate to bottom	37	2702

"A little oil and gas at 1595'. Dry hole."

Quite a large gas field has been developed in Elk district on Blue creek near Coco P. O. Several records will now be given of this field.

Thomas Carpenter No. 1 Well Record (776).

Located in Elk district on south side of Blue Creek, one-half mile northwest of mouth of Laurel Fork. Completed August 1, 1912. Authority, United Fuel Gas Company. Elevation 775' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Sand	114	130
Slate	220	350
Sand	25	375
Slate	45	420
Lime	60	480
Slate	15	495
Lime	35	530
Sand	346	876
Coal	4	880
Slate	20	900
Lime	40	940
Sand	150	1090
Red rock	100	1190
Lime	30	1220
Slate	5	1225
Little Lime	30	1255
Slate	3	1258
Lime	10	1268
Pencil Cave	10	1278
Big Lime	150	1428
Red rock	55	1483
Sand, Big Injun	87	1570
Slate	2	1572
Sand, Squaw	88	1660
Slate	2	1662
Sand, Weir, gas	13	1675

"Gas well; hole full of water at 600'; gas at 1394'; main gas pay, 1667'-1675'. Production figured from pressure to be 11,711,000 cu. ft. daily."

This well begins about 40 feet under the Kanawha Black Flint, and the coal encountered at 880 feet is one of the New River beds.

Thomas Carpenter No. 2 Well Record (773).

Located in Elk district on Blue Creek, one-fourth mile north of Laurel Fork. Completed November 30, 1912. Authority, United Fuel Gas Company. Elevation 655' B.

	Thickness Feet.	Total Feet.
Quick sand	46	46
Sand	14	60
Slate	140	200
Lime	20	220
Slate	25	245
Sand	5	250
Coal, Winifrede	5	255
Slate	35	290
Sand	10	300

	Thickness Feet.	Total Feet.
Slate	15	315
Sand	25	340
Slate	15	355
Sand	20	375
Slate	60	435
Sand	270	705
Coal	5	710
Sand	90	800
Coal	5	805
Slate	20	825
Lime	45	870
Sand	140	1010
Red rock	95	1105
Sand, Maxton	35	1140
Slate	5	1145
Little Lime	30	1175
Slate	2	1177
Lime shells	3	1180
Pencil Cave	8	1188
Lime shells	2	1190
Pencil Cave	14	1204
Big Lime	160	1364
Sand, Big Injun	50	1414
Sand, Squaw	166	1580
Gas sand, Weir	10	1590
Black lime to bottom	2.5	1592.5

"Gas well; hole full of water at 60'; salt water at 640'; gas in Big Lime at 1260'; gas in Squaw sand at 1585'. Gauge in July, 1909, 5,252,000 cu. ft. daily."

The well begins about 100 feet under the **Kanawha Black Flint**, and from the record it would appear that the "Weir" sand in which the gas occurs is merely the basal portion of the "Squaw" sand.

THE HACKBERRY OIL FIELD.

The Hackberry oil field has been developed from the head of Fullers creek in Big Sandy district, near the mouth of Hackberry Branch of said creek, in a southern direction for a distance of about 2 miles. Its width thus far (July 1, 1913) is about one mile.

Several records will now be given of the wells in this field:

Goshorn No. 20 Well Record (712).

Located in Elk district on divide between waters of Falling Rock Creek and Laurel Fork of Blue Creek, 2.3 miles east of Carpenter's station. Completed June 7, 1913. Authority, O'Connell Oil Company. Elevation 1230'.

	Thickness Feet.	Total Feet.
Unrecorded	480	480
Coal, Stockton-Lewiston	5	485
Unrecorded	745	1230
Salt sand	430	1660
Red rock	140	1800
Little Lime	35	1835
Pencil Cave	5	1840
Lime	15	1855
Pencil Cave	5	1860
Big Lime	160	2020
Slate	7	2027
Red rock	38	2065
Sand, Big Injun	35	2100
Sand and breaks of slate	110	2210
White sand, "Weir," oil	35	2245
Slate to bottom	3	2248

10" casing, 20 feet; 8" casing, 160 feet; 6⅝" casing, 1806 feet; first oil at 2231 feet; gas at 2237 feet; second oil at 2237-2241 feet; oil well."

Goshorn No. 19 Well Record (737).

Located in Elk district on divide between waters of Falling Rock Creek and Laurel Fork of Blue Creek, 3 miles northeast of Carpenter station. Completed May 19, 1913. Authority, O'Connell Oil Company. Elevation, 1130' B.

	Thickness Feet.	Total Feet.
Soil, black shale, and shells	1080	1080
Salt sand	245	1325
Slate	15	1340
Lime	10	1350
Slate	10	1360
Hard, gritty lime	20	1380
Sand	100	1480
Lime	20	1500
Red rock	5	1505
Lime	60	1565
Slate	10	1575
Lime	5	1580
Red rock	45	1625
Slate and lime shells	50	1675
Hard sandy lime	10	1685
Slate and shells	35	1720
Little Lime	30	1750
Pencil Cave	5	1755
Lime	30	1785

	Thickness Feet.	Total Feet.
Pencil Cave	5	1790
Big Lime	155	1945
Red rock and slate	30	1975
White sand, Big Injun	55	2030
Red sand	5	2035
Hard white sand	30	2065
Sand and lime shells	45	2110
Sand, "Weir," oil	65	2175

"10" casing, 17 feet; 8" casing, 800 feet; 6⅝" casing, 1789½ feet; half enough water to drill with at 100 feet; hole filled up with water in a rush at 1200 feet; gas at 1820 feet; first oil, 2148 feet; second oil, 2162 feet and 2165 feet."

Goshorn No. 17 Well Record (714).

Located in Elk district, on divide between waters of Falling Rock Creek and Laurel Fork of Blue Creek, 3 miles northeast of Carpenter station. Completed March, 1913. Elevation, 1070' B.

	Thickness Feet.	Total Feet.
Unrecorded	18	18
Sand	182	200
Slate	70	270
Coal, Stockton	5	275
Sand	5	280
Coal, Stockton	5	285
Sand	20	305
Coal, Coalburg	5	310
Shells	190	500
White sand	80	580
Slate	120	700
Sand	25	725
Shells	355	1080
Salt sand	420	1500
Slate	10	1510
Red rock	60	1570
Lime shells	55	1625
Sand, Maxton	20	1645
Slate	15	1660
Little Lime	25	1685
Pencil Cave	5	1690
Big Lime	175	1865
Slate	10	1875
Red rock	35	1910
Sand	90	2000
Slate	40	2040
Sand, "Weir," oil	40	2080
Slate to bottom	5	2085

"10" casing, 18 feet; 8" casing, 720 feet; 6⅝" casing, 1705 feet; water at 1150 feet and 1400 feet; "break" of 2 feet in Big Lime at 1700 feet; gas at 1850 feet; first oil, 2075 feet; gas at 2076 feet; second oil, 2076-2080 feet; oil well."

Testing for oil and gas has been done near the Kanawha-Clay county line by the Eldorado Oil and Gas Company. The following interesting record exhibits the succession of the different strata and oil sands in a well located on Lick Branch of Adonijah Fork of Sycamore creek:

Eldorado Oil & Gas Company No. 2 Well Record.

Located in Pleasant district, Clay county, 3.2 miles east of the Kanawha-Clay line and 7.5 miles northeast of Blakeley. Completed May 11, 1910. Authority. Eldorado Oil & Gas Company. Elevation, 905' A. T. B.

	Thickness Feet.	Total Feet.
Clay and gravel	23	23
Slate	2	25
Coal and slate, Kanawha Black Flint	5	30
Shale	15	45
Coal, Stockton-Lewiston	5	50
Sand	125	175
Coal, Winifrede	5	180
Slate	15	195
Coal, Chilton	5	200
Slate	20	220
Clay	15	235
Lime	15	250
Slate	15	265
Lime	15	280
Sand, broken	10	290
Slate	20	310
Lime	15	325
Sand	30	355
Coal	5	360
Slate	60	420
Lime	20	440
Slate	10	450
Lime	30	480
Slate	50	530
Sand, broken	15	545
Slate	55	600
Lime	14	614
Sand	26	640
Lime	10	650
Sand	70	720
Slate	50	770
Sand	65	835
Sandy lime	15	850
Sand	80	930
Slate, black	30	960
Lime, sandy	20	980

		Thickness Feet.	Total Feet.
Sand, close 30			
Sand, hard 45			
Sand, soft 80			
Sandy lime 40			
Sand, soft 20			
Sand, hard 20			
Sand, limy 15			
Sand, soft 10			
Sand, close 3	**Salt Sand**	395	1375
Sandy lime 27			
Sand, hard, fine 19			
Sandy lime 21			
Sandy lime, hard 33			
Sand, fine 12			
Sand, pebbly 15			
Sand, gray 5			
Slate, black		10	1385
Slate, gray		5	1390
Lime		10	1400
Lime, dark, sandy		6	1406
Sand, pebbly		10	1416
Lime		9	1425
Slate and shells		13	1438
Red rock		5	1443
Lime		6	1449
Red shale and lime		11	1460
Lime shells, sandy		5	1465
Red rock		3	1468
Shale		7	1475
Sand, gray 15			
Sand, dark 25	**Maxton**	45	1520
Sand, limy 5			
Slate and shale		13	1533
Pink shale and lime		15	1548
Lime shells		2	1550
Red shale		6	1556
Red shale and lime		16	1572
Dark red lime		8	1580
Slate, blue gray		8	1588
Slate, dark		6	1594
Slate, dark gray		7	1601
Cave		10	1611
Lime, dark brown 33			
Lime, dark gray 6			
Sandy lime 13	**Little Lime**	58	1669
Lime, soft, velvety 6			
Sand, "Blue Monday"		14	1683
Pencil Cave		5	1688

		Thickness Feet.	Total Feet.
Lime, dark 12			
Lime, dark brown 8			
Lime, white 10			
Lime, gray 28			
Lime, white 12			
Lime, brown 17			
Lime, gray, sandy 3	Big Lime	136	1824
Lime, brown 12			
Lime, gray, gritty 7			
Lime, brown 11			
Lime, brown, gritty 6			
Lime, gray, gritty 5			
Lime, gray, sandy 5			
Sand 5	Keener	19	1843
Sand, limy, white.....14			
Sand, light yellow 2			
Sand, blue gray 5			
Sand, close, white 3			
Sand, very hard, white..... 3			
Sand, yellow, hard 2			
Sand, white, very hard..... ½			
Sand, close, white 1½			
Sand, pebbly 4			
Sand, white glassy 4			
Sand, white, glassy 3	Big Injun	60	1903
Sand, extra close and very white 2			
Sand, brown, softer 4			
Sand, dark gray 5			
Sand, very dark 5			
Sand, black, large pebbles 6			
Sand, black, pebbles 10			
Black shale, sandy		9	1912
Red rock		3	1915
Red rock		15	1930
Lime		10	1940
Lime and shells		20	1960
Black shale		40	2000
Sandy lime		10	2010
Lime, gritty		20	2030
Slate, gray		47	2077
Dark slate and shale		15	2092
Slate		31	2123
Shale		25	2148
Sandy shale		10	2158
Slate		18	2176
Sandy shale and black slate		9	2185
Gray and black slate and shells		20	2205
Gray slate and shells		15	2220
Black slate and lime		20	2240
Gray slate and shells		35	2275
Black slate and shells		15	2290
Gray and black slate and shells		15	2305
Gray slate and shells		15	2320

	Thickness Feet.	Total Feet.
Gray shale	8	2328
Gray sandy shells	6	2334
Gray, gritty shale	22	2356
Very hard sandy shells	6	2362
Sandy shale	12	2374
Gray sandy shale	30	2404
Gray slate	5	2409
Gray, gritty shale to bottom	10	2419

"Gas at 614 feet, and show of oil at 620 feet; water at 1070 feet; big water at 1085 feet, and more water at 1116'; hole filled at 1750 feet; a little gas at 1235 feet; show of oil at 1824 feet; show of oil and gas at 1881 feet; 6⅝" casing, 1455 feet; 5 3-16" casing, 1698 feet; dry hole; well abandoned."

Prospective Oil and Gas Territory, Elk District.

Elk district has produced more oil and gas than any other district in Kanawha county, and has been prospected to a considerable extent, but there remains a large acreage of untested territory that is favored by geologic structure, and has not been condemned by present development. Considering these areas, northwest to southeast across the district, they come as follows: (1) Along the **Jarrett Syncline** on Little Sandy creek, if the lower sands are not broken up. (2) Along Blue creek, east of Sanderson. The well drilled by the South Penn Oil Company at Sanderson near the mouth of Shirkey Branch (770) showed traces of oil and gas, but the sands were broken. However, it is more than probable that sands to the west are unbroken, and in that event the geologic structure is favorable for oil. (3) Near the southeastern corner of the district just north of the Handley Syncline. (4) The Hackberry pool has not yet been fully defined. (5) It is more than probable that the Blue Creek Pool will extend farther south before it is fully determined in that direction.

BIG SANDY DISTRICT.

Big Sandy district occupies the northeastern portion of Kanawha county, and is bounded on the north by Roane county, and on the east by Clay. The axis of the Arches Fork anticline crosses through the northwestern corner of the district. The structure is generally favorable for the segregation of oil and gas into several pools.

The Blue Creek oil field extends in a northwestern direction into the district north of Elk river, and the Hackberry oil field extends in a northwestern direction into the region of Falling Rock creek south of Wier P. O., gas being found in commercial quantities at Clendenin and north of Elk river.

The following records are from wells located in the northern extension of the Blue Creek pool:

J. M. Young No. 1 Well Record (432).

Located in Big Sandy district, on north side of Elk River, one-half mile northwest of Walgrove station. Completed June 12, 1912. Authority, Ohio Fuel Oil Company. Elevation 617' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Gravel	39	55
Slate	20	75
Lime	25	100
Sand	40	140
Slate	180	320
Sand	100	420
Slate	25	445
Slate and shells	355	800
Slate and sand	380	1180
Slate	10	1190
Lime	20	1210
Slate	15	1225
Red rock	10	1235
Lime	20	1255
Slate	20	1275
Lime	25	1300
Slate	15	1315
Lime	25	1340
Slate	10	1350
Little lime	20	1370
Slate	3	1373
Lime	10	1383
Red rock	5	1388
Lime	5	1393
Slate	2	1395
Lime	2	1397
Red rock	3	1400
Lime 80 Sand 15 Slate 5 Lime 30 — Big Lime	130	1530
Sand, Big Injun	40	1570
Slate	88	1658
Oil sand, Squaw	18	1676

"Oil well; hole full of water at 870 feet."

Coal & Coke Ry. No. 1 Well Record (422).

Located one-half mile northeast of Walgrove, Elk district. Authority, Walnut Creek Oil Company. Completed May 14, 1912. Elevation 624' L.

	Thickness Feet.	Total Feet.
Unrecorded	1370	1370
Big Lime	140	1510
Unrecorded	120	1630
Sand, Squaw, oil	20	1650

"Oil well; first day's production, 1200 bbls. 10" casing, 28 feet; 8¼" casing, 400 feet; 6⅝" casing, 1391 feet."

Coal & Coke Ry. No. 5 Well Record (421).

Located in Big Sandy district, one-half mile southeast of Walgrove station. Authority, Walnut Creek Oil Company. Completed July 2, 1913. Elevation 630' L.

	Thickness Feet.	Total Feet.
Unrecorded	1370	1370
Big Lime	127	1497
Unrecorded	149	1646
Sand, Squaw, oil	16	1662

"10" casing, 26 feet; 8¼" casing, 345 feet; 6⅝" casing, 1396 feet; oil well; first day's production, 1350 barrels; second day's production, 1000 barrels."

This well is located in the center of the extension of the Blue creek pool.

A. P. Hayes No. 2 Well Record (423).

Located in Big Sandy district on south side of Elk River, one-half mile southeast of Walgrove station. Authority, Ohio Fuel Oil Company. Completed July 3, 1912. Elevation, 707' L.

	Thickness Feet.	Total Feet.
Conductor	16	16
Broken sand	44	60
Sand	153	213
Coal, Stockton-Lewiston	6	219
Slate	19	238
Sand	224	462
Slate	26	488
Sand	12	500
Black slate	40	540
White slate	20	560
Sand	85	645
Lime	30	675
Sand	180	855
Slate	15	870

	Thickness Feet.	Total Feet.
Lime	30	900
Slate	392	1292
Broken lime	8	1300
Red rock	6	1306
Shale	66	1372
Sand, Maxton	15	1387
Black slate	11	1398
Little Lime	46	1444
Red rock	6	1450
Black lime	20	1470
Big Lime	110	1580
Sand, Keener	15	1595
"Break"	124	1719
Oil sand, Squaw, oil	21	1740
"Oil well; oil at 1720'."		

This well is located in the center of the extension of the Blue Creek pool.

C. T. Wood No. 4 Well Record (293).

Located in Big Sandy district on north side of Elk River, 1 mile northeast of Walgrove. Authority, Ohio Fuel Oil Company. Completed November 10, 1912. Elevation 880' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Slate	84	100
Sand	70	170
Slate	40	210
Sand	200	410
Slate	60	470
Sand	230	700
Slate and shells	190	890
Sandy lime	40	930
Slate and shells	170	1100
Salt sand	390	1490
Slate	12	1502
Red rock	28	1530
Slate and shells	45	1575
Sand, Maxton	42	1617
Slate	2	1619
Little Lime	36	1655
Pencil Cave	13	1668
Big Lime	121	1789
Sand, Big Injun	40	1829
Slate and shells	68	1897
Black sand	20	1917
Slate	11	1928
Oil Sand, Squaw, oil	13.5	1941.5

M. R. Snyder No. 1 Well Record (599).

Located in Big Sandy district, on bank of Elk River, one-half mile north of Falling Rock station. Authority, South Penn Oil Company. Completed April 20, 1910. Elevation 905' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	20	20
Sand	30	50
Unrecorded	40	90
Red rock	50	140
Unrecorded	50	190
Sand	44	234
Slate	77	311
Sand	49	360
Lime	46	406
Coal, Stockton-Lewiston	5	411
Slate	17	428
Sand	57	485
Slate	11	496
Sand	89	585
Black slate	39	624
Sand	31	655
Black slate	15	670
Sand	20	690
Slate and shells	175	865
Sand	35	900
Slate	170	1070
First Salt sand	153	1223
Coal, New River	2	1225
Second Salt sand	218	1443
Black lime	18	1461
Red rock	4	1465
Black lime	26	1491
Slate	6	1497
Black lime	31	1528
Slate	4	1532
Lime	16	1548
Sand, Maxton	30	1578
Slate	6	1584
Red lime	36	1620
Pencil Cave	6	1626
Lime	10	1636
Pencil Cave	5	1641
Big Lime	144	1785
Big Injun sand	18	1803
Slate	77	1880
Sand, Squaw, gas	25	1905
Slate to bottom	25	1930

"Gas at 1115 feet; gas at 1735, 1787 and 1881 feet; gas well."

The above well was drilled in more than one year before the Blue Creek pool was discovered, and is located on the eastern edge of the pool.

C. T. Wood No. 6 Well Record (288).

Located on top of divide between Sand Run and Elk River, three-fourths mile northeast of Walgrove station. Authority, Ohio Fuel Oil Company. Completed December 6, 1912. Elevation 1100' B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Sand	214	230
Slate and shells	320	550
Sand	50	600
Coal	5	605
Lime	15	620
Lime, shells and slate	625	1245
Salt sand	450	1695
Sand, Maxton	91	1786
Little Lime	41	1827
Big Lime	139	1966
Sand, Big Injun	48	2014
Slate and shells	83	2097
Oil Sand, Squaw	12	2109

"Oil well; water at 1650 to 1680 feet; oil and gas at 2100 feet."

This well begins 20 feet under the base of what appears to be the Pittsburgh sandstone, which will make the interval between the base of the Pittsburgh sandstone and the top of the Big Lime, 1847 feet.

Lewis Wood No. 5 Well Record (506).

Located in Big Sandy district on Mill Fork of Jordans Creek, one mile north of Falling Rock station. Authority, United Fuel Gas Company. Completed June 6, 1913. Elevation 1010' A. T. B.

	Thickness Feet.	Total Feet.
Slate	80	80
Lime	10	90
Sand	25	115
Slate	50	165
Sand	55	220
Slate	60	280
Sand	20	300
Lime	10	310
Slate	42	352
Lime	8	360
Sand	60	420
Slate	20	440
Lime	10	450
Sand	40	490
Slate	10	500
Slate	90	590
Coal, Stockton-Lewiston	5	595
Slate	5	600

	Thickness Feet.	Total Feet.
Sand	25	625
Slate	20	645
Sand	36	681
Slate	109	790
Sand	5	795
Slate	12	807
Sand	21	828
Slate	72	900
Sand	20	920
Slate	25	945
Sand	80	1025
Slate	35	1060
Sand	5	1065
Gritty lime	10	1075
Slate	91	1166
Slate	8	1174
Salt sand	474	1648
Lime	2	1650
Slate	10	1660
Slate	5	1665
Sandy lime	20	1685
Sand, Maxton	25	1710
Slate	20	1730
Little Lime	35	1765
Lime	2	1767
Slate	4	1771
Sandy lime	2	1773
Pencil Cave	17	1790
Big Lime	140	1930
Sand, Big Injun	25	1955
Slate and shells	107	2062
Sand, Squaw, oil and gas 2064'-2072'	15	2077

"Water at 1244 feet, 2½ bailers per hour; water at 1340-1360; little gas at 1930 to 1935 feet, in Big Lime and top of Big Injun; oil and gas, 2064-2072 feet."

The northeastern extent of the Blue Creek pool in Big Sandy district has not been fully defined with tests, but it is more than probable that it will not extend much farther beyond the present limits, as the R. M. Dye well (726), two miles in advance on Doctor Branch, does not contain oil, but produces gas.

R. M. Dye No. 1 Well Record (726).

Located in Big Sandy district on Doctor Branch of Sandy Creek, three-fourths mile northwest of Clendenin. Authority, United Fuel Gas Company. Completed January 16, 1913. Elevation 795' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Unrecorded	204	220
Sand	122	342
Coal, Stockton-Lewiston	3	345
Lime shells and slate	165	510
Sand	135	645
Slate and shells	200	845
Gas sand	30	875
Slate	111	986
Salt sand	376	1362
Slate	30	1392
Lime	38	1430
Sand, Maxton	100	1530
Little Lime	15	1545
Slate	4	1549
Big Lime, gas, 1625'	151	1700
Sand, Injun, gas 1705'-1725'	45	1745
Slate	37	1782
Total depth	...	1782

"Gas well; calculated volume 1,770,000 cu. ft..; water, 1080-1090 feet; "break" in Salt sand at 1240-1265 feet; gas at 1625-1705, 1725 feet."

George Rucker No. 1 Well Record (595).

Located in Big Sandy district on Wills Creek, 3.3 miles north of Walgrove. Authority, United Fuel Gas Company. Completed January 8, 1908. Elevation 820' A. T.

	Thickness Feet.	Total Feet.
Drift	32	32
Red rock	128	160
Slate	40	200
Sand	60	260
Slate	40	300
Sand	150	450
Slate	20	470
Sand and slate	150	620
Sand	30	650
Coal, No. 2 Gas	4	654
Sand	56	710
Slate	350	1060
Salt sand	390	1450
Slate	50	1500
Sand, Maxton	75	1575
Little Lime	30	1605
Shale	31	1636
Big Lime	121	1757
Slate	1	1758

	Thickness Feet.	Total Feet.
Sand, Keener	12	1770
Sand, Big Injun, gas	46	1816
Slate to bottom	6	1822

"Gas well; trace of oil at 1800 feet."

J. R. Ryan No. 1 Well Record (596).

Located in Big Sandy district, on waters of Little Sandy Creek, 5 miles northwest of Clendenin, and 1.5 miles northwest of Rucker well. Authority, United Fuel Gas Company. Completed November 15, 1907. Elevation 760' B.

	Thickness Feet.	Total Feet.
Drift	16	16
Red rock	99	115
Slate	245	360
Sand	110	470
Shells	40	510
Sand	90	600
Broken	110	710
Sand	40	750
Broken	175	925
Sand	75	1000
Slate	10	1010
Salt sand	398	1408
Broken	22	1430
Blue Lime	20	1450
Sand, Maxton	35	1485
Little Lime	65	1550
Pencil Cave	5	1555
Big Lime	126	1681
Sand, Big Injun, gas	44	1725
Slate to bottom	9	1734

"Gas well; show of gas at 1105 feet and at 1670 feet; gauge July, '09, 2,792,000 cu. ft."

The following is a record of the John Board No. 1 well at that point, 5 miles east of the Ryan well:

John Board No. 1 Well Record (589).

Located in Big Sandy district on Sandy Creek at Wellford. Authority, United Fuel Gas Company. Completed January 29, 1901. Elevation 610' B.

	Thickness Feet.	Total Feet.
Unrecorded	850	850
Salt sand	484	1334
Little Lime	36	1370
Pencil Cave	5	1375
Big Lime, gas	130	1505
Sand, Big Injun, to bottom, gas	41	1546

"Water at 900 feet; gas in Big Lime at 1930 feet; gas in Big Injun, 1505-1546 feet; gas well; capacity, 7,473,589 cu. ft."

J. E. Deel No. 1 Well Record (732).

Located in Blue Creek of Sandy Creek in Big Sandy district, 3.5 miles northeast of Clendenin and 3 miles southeast of Wellford. Authority, United Fuel Gas Company. Completed March 13, 1910. Elevation 860' A. T.

	Thickness Feet.	Total Feet.
Unrecorded	10	10
Sand	130	140
Unrecorded	95	235
Coal, No. 5 Block	6	241
Sand	12	253
Unrecorded	157	410
Coal, Stockton-Lewiston	2	412
Unrecorded	29	441
Coal, Coalburg	6	447
Unrecorded	17	464
Sand	66	530
Sand	25	555
Coal	3	558
Unrecorded	62	620
Sand	105	725
Break	15	740
Unrecorded	215	955
Gas sand	52	1007
Break	6	1013
First Salt sand	362	1375
Break	6	1381
Second Salt sand	49	1430
Break	5	1435
Sand, Maxton	55	1490
Little Lime	30	1520
Break	5	1525
Pencil Cave	15	1540
Big Lime	100	1640
Sand, Big Injun, gas 1645-1656	22	1662

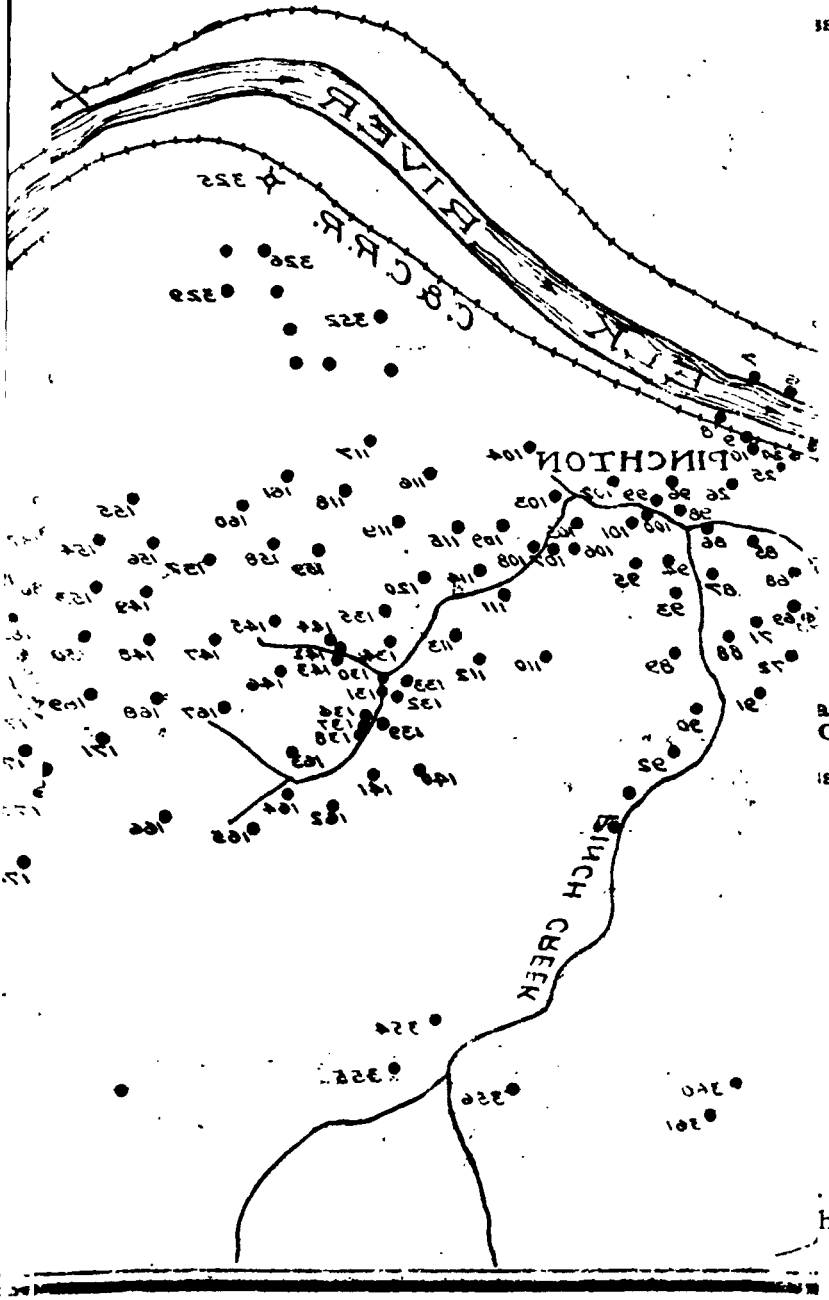
"Gas well; calculated volume, 4,817,000 cu. ft.; hole full of water at 1160 feet."

A considerable gas field has been developed in the Big Injun sand at Clendenin. The following records exhibit the different sands in that locality:

James Belcher No. 1 Well Record (722).

Located in Big Sandy district, one-half mile southwest of Clendenin, on north side of Elk river. Authority, United Fuel Gas Company. Completed February 15, 1913. Elevation 750' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	12	12
Sand	118	130
Slate, No. 5 Block Coal Horizon	5	135



Total Feet.
220
260
280
445
451
700
730
940
1235
1239
1440
1449
1488
1518
1533
1539
1666
1681
1765
1875
1880
1895
1913

cu. ft."

at Clen-
October

Total Feet.
12
225
290
760
860
1000
1003
1442
1480
1490
1600
1710
1850
1851

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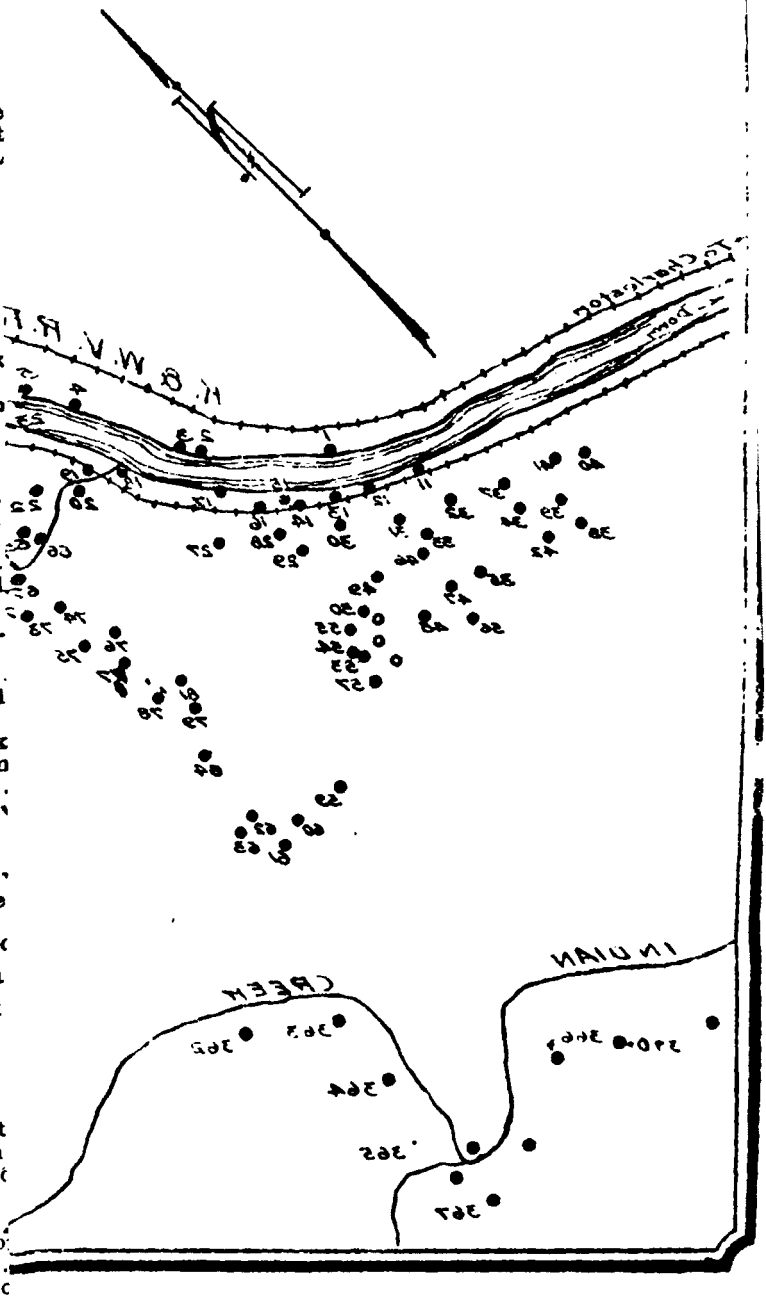

Located
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vation 860' .

Unrecorded
Sand .....
Unrecorded
Coal, No. 5
Sand .....
Unrecorded
Coal, Stock
Unrecorded
Coal, Coalb
Unrecorded
Sand .....
Sand .....
Coal .....
Unrecorded
Sand .....
Break ....
Unrecorded
Gas sand
Break ....
First Salt
Break ....
Second Sal
Break ...
Sand, Max
Little Lim
Break ....
Pencil Ca
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Conducto
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	Thickness Feet.	Total Feet.
Sand	85	220
Slate	40	260
Sand	20	280
Unrecorded	165	445
Coal, Winifrede?	6	451
Unrecorded	249	700
Sand	30	730
Unrecorded	210	940
First Salt sand	295	1235
Unrecorded	4	1239
Second Salt sand	201	1440
Unrecorded	9	1449
Sand, Maxton	39	1488
Little Lime	30	1518
Unrecorded	15	1533
Pencil Cave	6	1539
Big Lime	127	1666
Big Injun sand	15	1681
Break	84	1765
Sand, Squaw, gas at 1865	110	1875
Slate	5	1880
Broken slate and sand	15	1895
Sand to bottom	18	1913

"Show of oil at 1902 feet; calculated gas volume, 1,079,000 cu. ft."

M. A. Cobb No. 1 Well Record (582).

Located in Big Sandy district, on north side of Elk river, at Clendenin. Authority, United Fuel Gas Company. Completed October 5, 1912. Elevation 775' A. T. B.

	Thickness Feet.	Total Feet.
Soil	12	12
Sand	213	225
Slate	65	290
Slate and shells	470	760
Slate	100	860
Sand, gas, 960'	140	1000
Slate	3	1003
Salt sand	439	1442
Sand, Maxton	38	1480
Pencil Cave	10	1490
Big Lime, gas 1564'	110	1600
Slate and shells	110	1710
Sand, Squaw, gas, 1715', 1762' and 1782'	140	1850
Slate to bottom	1	1851

"Gas well; calculated capacity, 3,196,000 cu. ft."

Southwest from Clendenin 1.5 miles at the A. J. & B. Kelly well, both oil and gas were encountered, as shown in the following record:

A. J. & B. Kelly No. 1 Well Record (721).

Located in Big Sandy district on north side of Elk River, 1.5 miles southwest from Clendenin. Authority, United Fuel Gas Company. Completed June 1, 1913. Elevation 610' A. T. B.

	Thickness Feet.	Total Feet.
Red rock	40	40
Quick sand	35	75
Slate	50	125
Sand	45	170
Coal, No. 5 Block	2	172
Slate	78	250
Sand	30	280
Coal, Stockton-Lewiston	5	285
Slate	15	300
Sand	50	350
Lime shells	150	500
Sand	125	625
Slate	55	680
Sand, gas	15	695
Slate	5	700
Sand, First Salt	95	795
Slate	5	800
Sand, Second Salt	350	1150
Lime shells	55	1205
Red rock	7	1212
Sand, Maxton	63	1275
Little Lime	30	1305
Blue muck	2	1307
Sandy lime	10	1317
Pencil Cave	4	1321
Big Lime, gas, 1443'	136	1457
Sand, Big Injun, gas, 1457'-1467'	21	1478
Slate and shells	77	1555
Sand, Squaw, gas, 1630, 1672 and 1683 feet	130	1685
Oil sand, Weir	36	1721
Slate to bottom	7	1728

Gray sand, 1685 to 1695; white oil sand, 1695-1721; calculated gas, 1,135,000 cu. ft.; oil flowed 30 bbls. first day.

Ed Haynes No. 3 Well Record (534).

Located in Big Sandy district on Jordans Creek, 3.5 miles southwest of Clendenin. Authority, Summit Oil & Gas Company. Completed May, 1913. Elevation 650' A. T. D.

	Thickness Feet.	Total Feet.
Unrecorded	30	30
Sand	55	85
Unrecorded	110	195
Coal, No. 5 Block	5	200
Unrecorded	40	240
Sand	25	265
Slate	42	307

	Thickness Feet.	Total Feet.
Sand	23	330
Unrecorded	6	336
Coal, Stockton-Lewiston	4	340
Unrecorded	8	348
Sand	10	358
Unrecorded	2	360
Shell	184	544
Sand	38	582
Slate and shale	68	650
Sand	40	690
Break	45	735
Sand	30	765
Break	35	800
Gas sand	41	841
Break	5	846
Salt sand	399	1345
Sand, Maxton	85	1330
Little Lime	25	1355
Break	35	1390
Lime	5	1395
Pencil Cave	15	1410
Big Lime	135	1545
Sand, Big Injun	40	1585
Break	35	1620
Lime, hard	20	1640
Break	20	1660
Lime	14	1674
Sand, Squaw, to bottom	17	1691

Oil well; water enough to drill at 356 feet; hole full of water at 960 feet; little gas in top of Big Injun; a show of oil at 1674 feet; "pay" 1676' to 1686'.

Lewis & Brown No. 1 Well Record (810).

Located in Big Sandy district, on divide between Falling Rock and Leatherwood Creeks. Authority, United Fuel Gas Company. Completed January 9, 1913. Elevation, 1190' A. T. B.

	Thickness Feet.	Total Feet.
Shale	27	27
Sand	203	230
Slate and lime	197	427
Sand	85	512
Big Lime	38	550
Sand	155	705
Red rock (?)	75	780
Sand	68	848
Lime and shells	34	882
Big shale	66	948
Sand	24	972
Lime	38	1010
Sand and shells	75	1085
Lime	43	1128

	Thickness Feet.	Total Feet.
Gas sand	54	1182
Break	8	1190
Salt sand	380	1570
Slate and lime	15	1585
Sand	12	1597
Lime	18	1615
Red rock	6	1621
Hard sand	14	1635
Red rock	75	1710
Lime shells	30	1740
Sand, Maxton	20	1760
Slate	10	1770
Little Lime	26	1796
Break	35	1831
Pencil Cave	9	1840
Big Lime	161	2001
Slate	25	2026
Sand, Big Injun	65	2091
Red sand, Squaw	50	2141
White sand, big gas at bottom	35	2176

Gas well; calculated volume, 10,170,000 cu. ft.

On Leatherwood creek, south of the Kelly well (721) several wells have been drilled for gas. The following record exhibits the different sands in that locality:

G. G. Reynolds No. 1 Well Record (571).

Located in Big Sandy district, on Malcolm Branch of Leatherwood Creek, one mile south of Reamer. Authority, United Fuel Gas Company. Completed November 18, 1912. Elevation, 655' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	16	16
Lime	120	136
Sand	114	250
Slate	15	265
Sand	235	500
Slate	50	550
Broken up	150	700
Salt sand	500	1200
Red rock	10	1210
Slate	100	1310
Sand, Maxton	15	1325
Little Lime	23	1348
Pencil Cave	4	1352
Big Lime	132	1484
Big Injun Sand, gas 1484', 1499' and 1520'	36	1520
Broken sand and slate	97	1617
Squaw Sand, gas, 1703'	113	1730
Slate to bottom	3	1733

Gas well; calculated volume, 1,510,860 cu. ft.

The Falling Rock Cannel Coal Company of Charleston, W. Va., was among the first to develop the Hackberry oil field, when it began to drill on a large boundary of land owned by the company on Falling Rock creek in Kanawha county.

The following is the record of their well No. 1 drilled at Weir P. O., where the producing sand received its local name of the "Weir Sand."

Falling Rock Cannel Coal Company No. 1 Well Record (747).

Located in Big Sandy district on Falling Rock Creek at Weir P. O. Completed in 1911. Elevation 644' A. T. L.

	Thickness Feet.	Total Feet.
Conductor	20	20
Sand	60	80
Slate, black	25	105
Lime, sandy	35	140
Sand	20	160
Slate, white	40	200
Sand	30	230
Slate, brown	10	240
Slate, white	40	280
Lime	20	300
Sand	33	333
Slate, white	47	380
Sand	20	400
Shale, black	6	406
Shale, white	44	450
Lime, sandy	70	520
Shale, brown	30	550
Lime	70	620
Slate, white	10	630
Lime	30	660
Sand	220	880
Lime	60	940
Salt sand	140	1080
Lime	20	1100
Red rock, cave	5	1105
Slate, white	25	1130
Red rock, cave	60	1190
Slate, white	50	1240
Salt (Little) Lime	60	1300
Pencil Cave	15	1315
Big Lime	140	1455
Sand, broken	30	1485
Red Lime	30	1515
Slate and sand, Injun	85	1600
Sand, "Weir" (Squaw), gas 1605 and 1640	95	1695
Slate	162	1857
Shale, brown	13	1870
Sand with pebbles	5	1875
Slate and shells to bottom	465	2340

Gas well in Weir sand; salt water at 745 feet; gas, 1605 and 1640 feet.

Goshorn No. 4 Well Record (536).

Located in Big Sandy district, on Jones Branch of Falling Rock Creek. Authority, O'Connell Oil Company. Completed 1912. Elevation 880' A. T. B.

	Thickness Feet.	Total Feet.
Soil	40	40
Coal, No. 5 Block	3	43
Slate	82	125
Sand	125	250
Lime	15	265
Slate	30	295
Slate and lime	225	520
Lime	5	525
Slate and lime	195	720
Salt sand	200	920
Water	35	955
Slate	59	1014
Sand	201	1212
Black slate	10	1225
Sand	15	1240
Black slate	4	1244
Lime	16	1260
Red rock	3	1263
Sand	17	1280
Red rock	35	1315
Black slate	15	1330
Lime	10	1340
Black slate	6	1346
Lime	19	1365
Black slate	4	1369
Lime	15	1384
White sand (Maxton)	39	1423
"Break"	2	1425
Brown sand	15	1440
Pencil cave	5	1445
Lime, oil 1560'	25	1470
Sand	140	1610
Red rock	15	1625
Break	20	1645
Red sand	5	1650
Black sand	70	1720
Red sand	10	1730
White sand	15	1745
Break	15	1760
Weir sand	10	1770
Break	25	1795
2d Weir sand	20	1815
Break	25	1840
Sand to bottom	32	1872

1st oil, 1855'; 2nd oil, 1864'-1872'; Gas, 1525';Gas, 1770'.

This well was the first one drilled in the Hackberry field that produced oil in large quantity.

G. G. Reynolds No. 2 Well Record (804).

Located in Big Sandy district on divide between Falling Rock and Leatherwood creeks, 3.2 miles south of Reamer station. Authority, Ohio Fuel Oil Company. Completed, March 12, 1913. Elevation 1105' A. T. B.

	Thickness Feet.	Total Feet.
Slate	10	10
Sand	60	70
Slate	30	100
Sand	75	175
Slate	10	185
Sand and shells	375	560
Coal, Winifrede?	5	565
Sand	195	760
Black lime and slate	60	820
Sand	100	920
Slate	5	925
Lime and sand	35	960
Salt sand	510	1470
Red rock	10	1480
Lime	40	1520
Red rock	32	1552
Lime and sand	123	1675
Slate	5	1680
Little Lime	30	1710
Slate and shells	25	1735
Pencil cave	4	1739
Big lime	180	1919
Red sand	117	2036
White sand, "Weir"	95	2131
Oil sand	7	2138
Total depth	...	2146

Oil Well in Weir sand.

In the eastern part of Big Sandy district, on Morris creek, several wells have recently been drilled by the Raven Carbon Company on property of King Land Company.

King Land Company No. 3 Well Record (657).

Located in Big Sandy district on East fork of Morris creek, 1.5 miles southeast of Turner. Authority, Raven Carbon Company; completed April 4, 1913. Elevation 820' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	15	15
Unrecorded	30	45
Lime	25	70
Coal, Stockton-Lewiston	5	75
Sand	60	135
Slate	10	145
Sand	20	165

	Thickness Feet.	Total Feet.
Coal, Coalburg	5	170
Lime	30	200
Slate	15	215
Sand	20	235
Slate	15	250
Sand	50	300
Slate	140	440
Sand	20	460
Slate	55	515
Sand	50	565
Slate	10	575
Sand	60	635
Black slate	55	690
Sand	230	920
Lime	60	980
Sand	140	1120
Slate	18	1138
Lime	47	1185
Sand	30	1215
Slate	5	1220
Sand	25	1245
Slate	17	1262
Lime and sand	90	1352
Sand	2	1354
Little Lime	41	1395
Slate	5	1400
Lime	15	1415
Pencil cave	13	1428
Big Lime, oil 1538'	112	1540
Big Injun, oil 1542' and 1560'	60	1600

140 feet of 10" casing; 1428 feet of 6⅝" casing. Hole full of water at 1185'.

D. E. Taylor No. 1 Well Record (585).

Located in Big Sandy district on Barren creek, 1 mile north of Barren P. O. Authority, O. L. Davis, Vice-president and General Manager of Eastern Carbon Black Company. Completed December, 1912. Elevation, 635' A. T. B.

	Thickness Feet.	Total Feet.
Quick sand and gravel	20	20
Sand	30	50
Slate	25	75
Sand	75	150
Slate	25	175
Sand	25	200
Slate	50	250
Sand	70	320
Slate	30	350
Sand	145	495
Salt sand	520	1015
Red rock	15	1030
Sand	20	1050

	Thickness Feet.	Total Feet.
Slate and shells	50	1100
Sand, Maxton	100	1200
Slate	10	1210
Little Lime	28	1238
Pencil Cave	14	1252
Big Lime	112	1364
Sand, Big Injun, gas at 1370'	26	1390
Red rock	15	1405
Black slate	95	1500
Slate and shells	300	1800
Slate to bottom	85	1885

10" casing, 20 ft.; 8" casing, 495 ft.; 6½" casing, 1271 ft.

Prospective Oil and Gas Territory, Big Sandy District.

Big Sandy district stands second of the magisterial districts within the boundary of Kanawha county in production of oil and gas. There yet remain, however, considerable areas covering quite a large acreage in different parts of the district that are favored both by structure and present development to warrant further drilling. (1) That portion of the region lying in the northwestern part of the district along the head waters of Wills creek, across which the Robinson syncline passes as outlined on the structural map. (2) West of Clendenin and north of Reamer, just west of the Clendenin gas field, the indications are that there will be developed a small pool, as the Kelly heirs well No. 1 (720) is producing considerable oil in addition to the gas. (3) It is more than probable that light oil wells in the "Weir" sand will be developed on Falling Rock creek, to the north from the pool south of said creek, connecting the pool south of the creek with that north of the creek. (4) It is possible that gas and a small oil pool will be developed south of Queen Shoals along the Clay-Kanawha county line.

LOUDON DISTRICT.

Loudon district lies south of the center of the county and west of Washington district. The Warfield anticline crosses through the southern part of the district in a northeast-southwest direction.

Some prospecting for oil and gas has been done in this district. In the northern part of the district several wells have

been drilled, some of which show gas and a little oil, while in the southern part of the district, gas has been found of commercial value. Detailed records of a few of the wells will now be given:

Mrs. Blaine No. 1 Well Record (641).

Located in Loudon district, near the mouth of Joblin Branch, one mile east of South Charleston station. Authority, Cog City Oil & Gas Company. Completed June 21, 1912. Elevation, 594' L.

	Thickness Feet.	Total Feet.
Sand and gravel	43	43
Sand	42	85
Slate	18	103
Coal, No 5 Block	2	105
Slate	15	120
Lime	40	160
Sand, white	36	196
Slate	4	200
Sand, gray	25	225
Slate	3	228
Sand, gray	92	320
Slate	10	330
Lime	10	340
Slate	5	345
Lime	10	355
Coal, cannel, Winifrede	5	360
Lime	45	405
Slate and lime shells	55	460
Lime, sandy and hard	28	488
Sand	12	500
Slate and shells	130	630
Sand	60	690
Slate	10	700
Sand, Salt	210	910
Slate	8	918
Lime	47	965
Sand, water 1010'	100	1065
Slate	1	1066
Sand	14	1080
Slate	20	1100
Sand	20	1120
Slate	30	1150
Sand, gray	80	1230
Slate	2	1232
Sand	123	1355
Little Lime	32	1387
Pencil Cave	7	1394
Big Lime	171	1565
Slate	10	1575
Sand, Big Injun	28	1603
Red rock	32	1635
Slate and shells	305	1940
Sand, gray	3	1943

	Thickness Feet.	Total Feet.
Slate and shells	94	2037
Sand, Berea	8	2045
Lime, black	24	2069
Slate	4	2073

10" casing, 43 feet; 8⅝" casing, 565 feet; 6¼" casing, 1414 feet; hole full of salt water at 805 feet; small showing of black oil at 1943 feet. Berea very hard with smell of oil; dry hole; well abandoned.

The Big Injun sand appears to be 28 feet thick, while the "Squaw" sand appears to be entirely absent, and the Berea is only 8 feet thick and very hard.

J. H. Huling No. 1 Well Record (639).

Located in Loudon district, on Middle Fork of Davis Creek, 4.2 miles southwest of Charleston. Authority, J. H. Huling, Charleston, W. Va. Completed 1909. Elevation 690' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	18	18
Unrecorded	7	25
Buff sand	21	46
Coal, slaty, Coalburg	2	48
Black shale	42	90
Coal, Winifrede, Black Band	3	93
Sand	40	133
Black shale	57	190
Cannel Coal, Thacker?	5	195
White sand, gas and show of oil	25	220
Unrecorded	92	312
Black shale	108	420
Sand, gas	36	456
Shale	64	520
Sand	10	530
Slate and shells	270	800
Coal?	5	805
Sand	155	960
Slate	121	1081
Sand	167	1248
Red rock, broken	20	1268
Lime	44	1312
Sand mixed with water	48	1360
Little Lime	40	1400
Pencil Cave	4	1404
Big Lime	136	1540
Red rock, break	10	1550
Sand, Big Injun	50	1600
Slate and shells	135	1735
Lime and sand	85	1820
Shells and slate	172	1992
Red rock	8	2000
Black shale	6	2006
Berea sand	10	2016
Hard lime shells to bottom	64	2080

8¼" casing, 530 feet; 6¼" casing, 1368 feet.

The tidal elevation of the top of the Berea sand is 1316 feet below tide, compared with 1443′ in the Blaine well (641). A rise of 127 feet in 4 miles, or about 32 feet to the mile. The coal reported at 800 feet would belong in the New River group, and is probably mostly black slate.

Record of J. H. Huling et al. No. 1 Well (640).

Located in Middle Fork of Davis Creek on east side; drilled by Miller Oil Company. Elevation 730′ A. T. B.

	Thickness Feet.	Total Feet.
Sand and shale	140	140
Coal, Thacker?	4	144
Sandstone and shale, little gas, 190′	46	190
Sandstone and shale	332	522
Sand, (Sugar)	42	564
Shale, soft	38	602
Shale, hard	4	606
Sand	6	612

Flow of gas at 606′ and oil filled up 75″ in hole; well shot with 10 quarts; gave a big flow of salt water; well pumped 15 days and got 40 barrels of green oil.

Huling No. 2 (639A).

Another well located three-fourths mile southeast from Huling No. 1, produced a small quantity of oil on top of the Salt sand at 630 feet, but the well was soon abandoned.

Bradford No. 1 Well Record (636).

Located in Loudon district on Davis Creek at mouth of Shrewsbury hollow, one mile northeast of Chilton. Authority, Landon Oil & Gas Company. Completed July 25, 1912. Elevation 740′ A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	40	40
Coal, Thacker	0-6″	40-6″
Unrecorded	79-6″	120
Coal, Cedar Grove?	2	122
Sand	378	500
Unrecorded	100	600
Salt sand	200	800
Slate	50	850
Salt sand	250	1100
Unrecorded	60	1160
Sand?	40	1200
Lime	80	1280
Big Lime	145	1425
Big Injun, gas	35	1460

	Thickness Feet.	Total Feet.
Brown shale	340	1800
Sand shell, Berea	20	1820
Blue lime	30	1850

10" casing, 32 feet; 8" casing, 620 feet; 6⅝" casing, 1411 feet. Show of oil at 380, 490 and 630 feet; gas at 1430 feet, about 10,000 cu. feet.

This well is located three miles southeast of the Huling well (639), and the top of the Berea sand is 1080 feet below tide, compared with 1316 in the Huling well, a rise of 236 feet in three miles or 112 feet per mile, showing a rapid rise of the strata towards the Warfield anticline. The Salt sand at 630 feet produced a small showing of oil.

Southwest of this, on Lens creek, three wells have been drilled near the crest of the Warfield anticline, two of which have produced gas.

Gould & Parker No. 1 Well Record (648).

Located in Loudon district, on Lens Creek, at mouth of Left Fork, 1.5 miles southwest of Marmet. Authority, J. W. Penhale. Completed, 1896. Elevation, 619' A. T. L.

	Thickness Feet.	Total Feet.
Sand and slate	840	840
Shale	200	1040
Big Lime, gas, 1085' to 1105'	160	1200

Well made about 250,000 feet of gas daily.

Gould & Parker No. 2 Well Record (649).

Located on Left Fork of Lens Creek, 1.8 miles southeast of Marmet. Authority, J. W. Penhale. Completed May 11, 1896. Elevation, 625' A. T. B.

	Thickness Feet.	Total Feet.
Sand	120	120
Slate	80	200
Sand	200	400
Coal, possibly Sewell horizon	4	404
Sand	296	700
Dark shale	280	980
Lime	240	1220
Red rock	2	1222

Dry hole; well abandoned.

This well begins about 150 feet under the No. 2 Gas coal, so that the seam encountered at 400 feet is possibly the Sewell bed, although it is probably mostly black slate, as in the core drill hole put down at Kanawha Falls.

Several salt wells were once drilled on the south side of Kanawha river, between Marmet and Charleston, and the salt water used for the manufacture of salt. At the mouth of Right Hand Fork of Rush creek a well was drilled for gas about 16 years ago, but was found dry and abandoned.

A well has recently been drilled on the Ward property by F. W. Abney.

F. W. Abney No. 1 Well Record (643).

Located in Loudon district, on Venable Branch, a short distance above Charleston, one mile southeast of South Ruffner station. Authority, F. W. Abney. Completed June 12, 1913. Elevation, 690' A. T. B.

	Thickness Feet.	Total Feet.
Quick sand and gravel	35	35
Black slate	5	40
Slate	40	80
Coal, Chilton	1	81
Slate	100	181
Coal, Thacker?	4	185
Black slate	55	240
Lime and shells	60	300
Sand	60	360
Black slate	20	380
Sand	28	408
Sand and shells	32	440
Coal, Eagle?	5	445
Slate	4	449
Salt sand	381	830
Coal, Sewell?	6	836
Black slate and shells	64	900
Sand	150	1050
Sandy lime	45	1095
Sand	15	1110
Black slate	10	1120
Sand, Maxton	30	1150
Slate	2	1152
Little Lime	38	1190
Black lime shells	5	1195
Pencil Cave	10	1205
Big Lime, gas, 75,000 cubic feet	175	1380
Red rock	25	1405
Blue lime shells	10	1415
Black slate	15	1430
Hard sand shells	5	1435
Black slate	180	1615
Sand shells with blue and black slate	195	1810
Brown sand shell	4	1814
Brown shale	20	1834
Berea sand	10	1844
Black slate	16	1860
Hard lime shells	5	1865
Slate	17	1882
Lime shells to bottom	5	1887

The Big Injun and Squaw sands appear to be absent, as sands.

The well begins 150 feet under the Kanawha Black Flint and 20 feet under the Winifrede coal. The coal encountered at 440 feet is possibly the Eagle coal. The elevation of the top of the Berea is 1154 feet below tide, compared with 1443′ in the Blaine well No. 1 (641), a rise of 289 feet in 4¾ miles, or at the rate of 60 feet per mile.

Prospective Oil and Gas Territory, Loudon District.

Although several wells have been sunk at different points in Loudon district, there yet remains a large acreage in the district that has not been condemned by dry holes. The southern portion is favored by geologic structure for gas in the Big Lime, and possibly in the Big Injun, and in the extreme southern portion of the district there may possibly be some oil in these sands. In the northwestern portion some oil has been found in the Huling No. 2 (640) in the Salt sand.

CHARLESTON DISTRICT.

Charleston district lies near the center of Kanawha county, south of Union and west of Malden and Elk districts. Salt wells were drilled along the Kanawha river at an early date, from which salt water was pumped and used in making salt. Several test wells have been drilled in this district for oil and gas, but thus far no oil of commercial value has been produced. A few records from this area will now be given:

West Virginia Clay Products Company No. 1 Well Record (652).

Located on water of Elk Two-Mile Creek, one mile southwest of Two-Mile station. Authority, Clay Products Company. Completed, 1912. Elevation, 620′ A. T. B.

	Thickness Feet.	Total Feet.
Mud and gravel	38	38
Sand	32	70
Coal, Winifrede?	5	75
Sand	100	175
Slate, black	75	250

	Thickness Feet.	Total Feet.
Sand	130	380
Coal, No. 2 Gas?	5	385
Sand	65	450
Slate	50	500
Salt sand	280	780
Slate	20	800
Sand and lime	100	900
Sand	100	1000
Slate, black	20	1020
Sand	40	1060
Sand and lime	15	1075
Sand, Maxton	145	1220
Black lime	40	1260
Pencil Cave	5	1265
Little Lime	11	1276
Pencil Cave	3	1279
Big Lime	166	1445
Sand, Big Injun	35	1480
Red rock	7	1487
Slate and shells	195	1682
Sand, Weir?	60	1742
Slate and shells to bottom	313	2055

Small gas well; water at 6 feet; show of gas and oil at 500 feet; hole full of water at 640 feet; show of gas at 1513 and 1616 feet; gas and oil at 1682 feet.

The well begins 30 feet under the Kanawha Black Flint, so that the coal encountered at 70 feet is possibly the Winifrede, and that at 380 feet is possibly the No. 2 Gas coal.

The sand encountered at 1682 feet is possibly the **"Weir" Sand.**

Another well drilled on the south bank of Elk river, near where the pumping station of the Kanawha Water & Light Company is now located, produced gas for a while. The following record published in Vol. I(A), page 501, West Virginia Geological Survey, 1904, exhibits the different sands.

City Water Works No. 1 Well Record (653).

Located in Charleston district, on south bank of Elk River, 1 mile northeast from its mouth. Authority, W. S. Edwards. Elevation, 610' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	28	28
Unrecorded	12	40
Shale	34	74
Coal, Stockton-Lewiston	2	76
Sandstone	74	150

	Thickness Feet.	Total Feet.
Shale	42	192
Coal, Winifrede?	...	...
Shale and sandstone	68	260
Limestone	20	280
Sandstone	60	340
Shale	60	400
Sandstone	70	470
Coal, No. 2 Gas	...	...
Unrecorded	20	490
Shale	20	510
Sandstone	50	560
Shale	30	590
Sandstone	355	945
Unrecorded	55	1000
Sandstone	170	1170
Shale	10	1180
Limestone 10' / Sand 60 / Limestone 200 / Unrecorded 25 / Sandstone, pebbly 40 — Big Lime and Big Injun	335	1515
Sandstone, red	85	1600
Sandstone, shelly and slaty	12	1612
Sandstone	80	1692
Slate to bottom	148	1840

The sand encountered at 1692 feet is possibly the "Weir."

Another well (654) was drilled in the western part of Charleston district, and all the sands were found dry. A well was also drilled in Ruffner hollow (651), and a small flow of gas was there encountered in the Big Injun.

In the early history of Charleston several salt wells were drilled near the mouth of Wilson hollow, and the salt water used in the manufacture of salt.

Prospective Oil and Gas Territory, Charleston District.

The wells already drilled in Charleston district seem to indicate that there is no probability of any large deposit of oil or gas within the district. It is probable that light gas wells will be encountered in the eastern portion of the district.

CABIN CREEK DISTRICT.

Cabin Creek district lies in the southwest portion of Kanawha county, being bounded on the north by Elk and Malden districts, and on the east by Fayette county. It is traversed

in the extreme northern portion by the **Warfield syncline,** in a northeast-southwest direction. The **Quincy syncline** extends for a short distance into the western portion in an almost east-west direction. The **Warfield anticline** enters the district for a short distance in the vicinity of Winifrede on Fielders creek. The **Coalburg syncline** crosses the Kanawha river in a northeast-southwest direction near Coalburg. The Hansford anticline runs nearly north across the Kanawha river at Hansford. The Handley syncline crosses the Kanawha river in a northeastern direction at Handley, and in the extreme southern end of the county the Wake Forest anticline crosses Cabin creek at Wake Forest in a northeastern direction. Gas of commercial value has been found in several portions of the district, but thus far no oil pool of economic value has been discovered in Cabin Creek district.

The records of several wells will now be given to show the occurrence of the different oil and gas sands:

Thompson No. 1 Well Record (691).

Located in Cabin Creek district on Mile Branch, one-half mile northeast of Monarch. Authority, Kanawha Valley Products Company. Completed April, 1912. Elevation, 685' A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	103	103
Sand	112	215
Unrecorded	85	300
Sand	28	328
Slate	122	450
Sand	88	538
Slate	182	720
Lime shells	180	900
Slate	130	1030
Salt sand	220	1250
Red rock	15	1265
Slate	105	1370
Little Lime	20	1390
Pencil Cave	10	1400
Slate	30	1430
Big Lime	90	1520
Red rock and shells	161	1681
Sand, "Squaw," gas	152	1833

First gas at 1717 feet; second gas at 1755 feet; third gas at 1790 feet; gas capacity, 2,750,000 cu. ft.; rock pressure, 480 lbs.; 12" wood conductor, 18 feet; 10" casing, 312 feet; 6⅝" casing, 1450 feet. The well begins 5 feet under the Cedar Grove Coal.

The R. O. Bailey No. 1 Well Record (693).

Located in Cabin Creek district, on south side of Kanawha River near Eastbank. Authority, United Fuel Gas Company. Completed January 10, 1912. Elevation, 760' A. T. B.

	Thickness Feet.	Total Feet.
Slate	30	30
Lime	20	50
Sand	30	80
Slate	60	140
Coal, Eagle?	3	143
Lime	40	183
Slate	30	213
Sand	82	295
Slate	10	305
Sand	205	510
Coal, show of	0	510
Sand	100	610
Slate	40	650
Sand, little gas 670'	175	825
Slate	20	845
Sand	135	980
Slate	85	1065
Red rock	83	1148
Slate	70	1218
Red rock	82	1300
Sand, Maxton	70	1370
Slate	100	1470
Big Lime	170	1640
Red rock	40	1680
Slate	40	1720
Sand, Squaw	170	1890
Slate	150	2040
Lime shells	40	2080
Slate	20	2100
Black slate	25	2125
Berea sand	20	2145
Slate to bottom	16	2161

Dry hole; well abandoned; a little gas at 670 feet, and a little water at 690 feet; some gas in lime at 1615 feet, and in "Squaw" at 1823 feet.

On Paint creek, southeast from Kanawha river, the United Fuel Gas Company drilled two wells on the property of the Paint Creek Land and Coal Company, one at Mucklow and one at Standard.

Paint Creek Land & Coal Company No. 1 Well Record (698).

Located in Cabin Creek district on Paint Creek, one-half mile southeast of Mucklow. Authority, United Fuel Gas Company. Completed May 2, 1911. Elevation, 760' A. T. B.

	Thickness Feet.	Total Feet.
Unrecorded	12	12
Flint rock	30	42
Sand	148	190
Coal, No. 2 Gas	1	191
Sand	49	240
Slate	20	260
Sand	300	560
Coal?	6	566
Sand	374	940
Slate	15	955
Sand	195	1150
Slate	40	1190
Red rock	150	1340
Lime	20	1360
Slate	60	1420
Red rock	20	1440
Lime, gas	26	1466
Sand	34	1500
Slate	20	1520
Sand, Maxton	70	1590
Little Lime	30	1620
Slate	20	1640
Lime	15	1655
Pencil Cave	5	1660
Black lime	15	1675
Slate and shells	50	1725
Big Lime	170	1895
Big Injun, red	45	1940
Slate	42	1982
Sand, Big Injun, gas	43	2025
Sand and slate	40	2065
Sand, "Weir," "Squaw"	47	2112
Dark slate	208	2320
Black slate	30	2350
Berea sand	39	2389
Slate to bottom	63	2452

Top of gas, 1466; volume, 350,000 cu. ft.; gas, 1988-2025; gas well; calculated volume, 744,000 cu. ft. The top of the Big Lime is 965 feet below tide, and the top of the Berea sand shows an elevation of 1590 feet below the same datum.

Paint Creek Land & Coal Company No. 2 Well Record (689).

Located in Cabin Creek district, one-half mile southwest from Standard P. O. Authority, United Fuel Gas Company. Completed September 8, 1911. Elevation, 733' A. T. B.

	Thickness Feet.	Total Feet.
Gravel	26	26
Slate	50	76
Sand	60	136
Slate	164	300

	Thickness Feet.	Total Feet.
Coal (?)	6	306
Slate	130	436
Sand	559	995
Slate	12	1007
Sand	33	1040
Red rock	85	1125
Sand	10	1135
Slate	100	1235
Lime	40	1275
Red rock	140	1415
Sand	20	1435
Lime shells and rock	65	1500
Slate	40	1540
Sand, Maxton	85	1625
Slate	50	1675
Little Lime	50	1725
Pencil Cave	15	1740
Big Lime	190	1930
Sand, Big Injun	45	1975
Slate	40	2015
Sand, "Weir," "Squaw"	160	2175
Slate	233	2408
Berea Grit	4	2412
Slate	88	2500
Lime shells	60	2560
Slate	160	2720
Lime shells	5	2725
Slate to bottom	304	3029

Dry hole; well abandoned.

The top of the Big Lime is 1007 feet below tide compared with 965 feet in No. 1 hole (698), a fall of 42 feet in 2 miles, or 21.0 feet per mile.

A test well for oil and gas was drilled near Winifrede several years ago by the Winifrede Coal Company, and the record of this well reads as follows:

Winifrede Coal Company No. 1 Well Record (699B).

Located in Cabin Creek district, 2 miles southeast of Winifrede P. O. Authority, R. B. Cassidy, Charleston. Elevation, 1065' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	32	32
Coal, Winifrede	5.5	37.5
Sandstone	60.5	98
Slate	5	103
Coal, Thacker	2.3	105.3
Sand and slate	19.7	125
Slate	25	150
Sand	115	265

	Thickness Feet.	Total Feet.
Slate and coal	10	275
Sand	39	314
Coal, No. 2 Gas	2	316
Slate	105	421
Coal	2	423
Sand	8	431
Quick sand	9	440
Sand	120	560
Coal	4	564
Slate	21	585
Sand with salt water	635	1220
Sand	235	1455
Slate	15	1470
Sand	105	1575
"Long running rock"	15	1590
Sand	160	1750
Slate	10	1760
Red shale	15	1775
Black slate	5	1780
Slate	10	1790
Red rock and shales	70	1860
Limestone, Big Lime	140	2000

The deepest bore hole in West Virginia was drilled in Cabin Creek district, on Slaughters creek, on land of Slaughters Creek Coal & Land Co. by the Wm. Seymour Edwards Oil & Gas Company, the record of which with comments thereon is given in another portion of this volume.

Schonk & Garrison No. 1 Well Record (699A).

Located in Cabin Creek district, on Tom Fork of Cabin Creek, one-half mile southwest of Leewood P. O. Authority, West Penn Oil Company. Well completed July, 1913. The well begins 15 feet under the No. 2 Gas coal. Elevation, 925' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	11	11
Coal, Powelton	3	44
Hard sandstone	54	68
Lime, sandstone	122	190
Shells and slate	125	315
Hard lime, sandstone	35	350
Slate	12	362
Hard lime, sandstone	68	430
Black lime, sandstone	20	450
Slate	5	455
Lime	30	485
Slate	10	495
Sand	150	645
Slate	5	650
Lime	65	715

	Thickness Feet.	Total Feet.
Sand	43	758
Lime	50	808
Sand	150	958
Slate	4	962
Sand	68	1030
Black lime	10	1040
Sand	135	1175
Black sand	15	1190
White sand	70	1260
Slate and lime	95	1355
Hard sand	25	1380
Slate	5	1385
Lime	50	1435
Red rock	28	1463
Hard sand	37	1500
Red rock	100	1600
White slate	20	1620
Sandy lime	60	1680
Red rock	55	1735
Lime	15	1750
Red rock	30	1780
Sand	25	1805
Sand, Maxton	60	1865
Soft, black shale	16	1880
Lime	26	1906
Shale	72	1978
Pencil Cave	12	1990
Big Lime	170	2160
Pink Break	10	2170
Sand, Keener, gray, limy	30	2200
Break, slate	35	2235
Sand, Indian, red, good sand	50	2285
Slate and shells	195	2480
Sand, Squaw?	5	2485
Slate and shells	49	2534
White slate	85	2619
Hard shell	6	2625
White slate	29	2654
Brown shale	15	2669
Sand, Berea	17	2686
Slate	14	2700
Total depth	...	2700

10" casing, 70 ft.; 6⅝" casing, 1575 feet; 5 3-16" casing, 2006 feet; 3 bailers of water at 190 feet; gas at 320 feet; 6 bailers of water at 975 feet; hole full of water at 1175 feet; red rock caved badly at 1500 to 1600 feet; gas in Big Lime at 2112 feet. Gas well.

Prospective Oil and Gas Territory, Cabin Creek District.

Very few wells have been drilled in Cabin Creek district, in search of oil or gas, and there yet remains a large acreage that has not been condemned by dry holes. Thus far only gas has been produced in this district, but the geologic structures

seem to indicate that there may be several small pools of oil within the district. However, the strata are fast thickening to the southeast in the Pottsville series, and it is questionable if the structure of the upper strata, will effect very much the lower oil and gas bearing sands. There appears to be plenty of sand in the Big Injun in the gas wells, at Cedar Grove. This sand is coarse grained but is reported as unusually hard, and hence claimed by old drillers to be not propitious for the production of oil, unless a change takes place in the sand, by softer material displacing the hard layers, when it is possible that productive wells will be found.

MALDEN DISTRICT.

Malden district lies north of the Kanawha river, being bounded on the east by Elk and Cabin Creek districts, and on the south by Cabin Creek and Loudon. The southern and eastern portions are traversed by the **Warfield anticline.** Several wells have been drilled in Malden district, but thus far no oil pool of commercial value has been discovered. A few small gas wells have been developed in the district.

Several records of wells will now be given to illustrate the rock successions:

S. C. Bowen No. 1 Well Record (658).

Located on Elk Two-Mile Creek, one-eighth mile northeast of mouth of Bakers Fork. Authority, United Fuel Gas Company. Completed August 18, 1910. Elevation, 660' A. T. B.

	Thickness Feet.	Total Feet.
Gravel	30	30
Lime	60	90
Slate	30	120
Lime	40	160
Coal, Winifrede	5	165
White Lime	80	245
Black slate	20	265
Sand	25	290
Blue Lime	60	350
Slate	55	405
Lime and shale	90	495
White slate	50	545
Sand	250	795
Lime	60	855
Slate	20	875

	Thickness Feet.	Total Feet.
Sand	90	965
Lime	40	1005
Sand	145	1150
Blue shale	18	1168
Sand, Maxton	75	1243
Little Lime	30	1273
Pencil Cave	5	1278
Big Lime	165	1443
Sand, Big Injun	30	1473
Red rock	80	1503
Slate and shale	188	1691
Sand, Squaw, gas 1692'; oil 1695', 1703' and 1716'	38	1729
Slate to bottom	134	1863

Gas well; estimated 300,000 cu. ft.

D. G. Courtney No. 1 Well Record (680').

Located on Campbell Creek, 2 miles southeast of Five-Mile station. Authority, Coal River Oil & Gas Company. Completed 1910. Elevation, 730' A. T. B.

	Thickness Feet.	Total Feet.
Gravel	20	20
Red clay	10	30
Sand	30	60
Slate	25	85
Coal, No. 2 Gas?	7	92
Slate	28	120
Sand	200	320
Rock slate	25	345
Sand	165	510
Slate	40	550
Sand	285	835
Slate	5	840
Lime	90	930
Slate	3	933
Sand	32	965
Red rock	20	985
Black slate	45	1030
Red lime	25	1056
Black lime	89	1144
Pencil Cave	10	1154
Big Lime	170	1324
Big Injun, red	70	1394
Slate	30	1424
Red sand	15	1439
Sand, Squaw	31	1470
Slate and shells to bottom	1045	2515

Dry hole; well abandoned; 10" casing, 28 feet; 8" casing, 280 feet; 6" casing, 1154 feet

The "Weir" and Berea sands seem to be absent in this well.

Further down Campbell creek, a short distance above Clover hollow, the W. D. Lewis well No. 1 was drilled, the record of which is as follows:

W. D. Lewis No. 1 Well Record (661).

Located on Campbell creek, ¼ mile northeast of Coal Fork P. O. Authority, Crescent Oil Company; completed August, 1912. Elevation 615' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	22	22
Sand	30	52
Coal, No. 2 Gas	3	55
Unrecorded, water	63	118
Slate	12	130
Sand	28	158
Slate	7	165
Sand	89	254
Coal	3	257
Lime and sand	83	340
Slate	10	350
Sand	91	441
Slate	20	461
Lime	9	470
Sand	60	530
Slate	10	540
Lime	32	572
Salt sand	183	755
Slate and lime shells	65	820
Lime	25	845
Sand	15	860
Lime	25	885
Sand	63	948
Slate and shells	28	976
Lime	16	992
Slate, Pencil Cave	4	996
Big Lime gas 1117', 1127' to 1129' and 1177'	239	1235
White sand, Big Injun	45	1280
Rock sand	20	1300
Red rock	25	1325
Black limy sand	25	1350
Slate and shale	145	1495
Slate	55	1550
Slate and shale	497.5	2047.5

10" casing, 75'; 8" casing, 460'; 6⅝" casing, 1104'; water at 584'; hole full of water at 684'; first gas at 1117'; more gas at 1127'-1129'; heavy flow of gas at 1177'; some gas at 1250'. Small gas well.

Made 1st Minute, 20 lbs. pressure.
Made 2nd Minute, 40 lbs. pressure.
Made 3rd Minute, 55 lbs. pressure.
Made 4th Minute, 65 lbs. pressure.
Made 5th Minute, 70 lbs. pressure.
Made 6th Minute, 75 lbs. pressure.
Made 7th Minute, 78 lbs. pressure.
Made 8th Minute, 79 lbs. pressure.
Made 9th Minute, 80 lbs. pressure.
Made 10th Minute, 80 lbs. pressure.
Made 60th Minute, 90 lbs. pressure.

On Fivemile creek of Campbell creek, the South Penn Oil Company drilled a well on the property of the Blue Creek Coal and Land Company, the record of which is as follows.

Blue Creek Coal and Land Company No. 3 Well Record (666).

Located in Malden district on Fivemile Fork of Campbell creek, 1 mile northeast of Fivemile station. Authority, South Penn Oil Company. Completed August 12, 1912. Elevation, 666' L.

	Thickness Feet.	Total Feet.
Conductor	0	0
Mud, slate and shells	320	320
Sand	60	380
Slate, lime and shells	125	505
Salt sand	640	1145
Red rock	55	1200
Maxton sand	22	1222
Slate	19	1241
Little Lime	29	1270
Pencil Cave	30	1300
Big Lime, gas 1361'	150	1450
Slate and shells	96	1546
Squaw sand, gas 1554'	20	1566
Slate and shells to bottom	552	2118

Gas at 1361'; gas, 1554'; well plugged and casing pulled; 10" casing, 41'; 8¼" casing, 43'; 6⅝" casing, 1308'.

On Kanawha river, south of Malden, near the crest of the Warfield anticline, several gas wells have been drilled. The following record shows the succession of the strata in this portion of Malden district.

John Q. Dickinson No. 1 (Burning Springs) Well Record (671).

Located in Malden district ¾ mile south of Washington Springs. Authority, William Seymour Edwards. Elevation 660' A. T. B.

	Thickness Feet.	Total Feet.
Conductor	53	53
Sand	100	153
Slate	8	161
Sand, smell oil	40	201
Slate	23	224
Sand	176	400
Coal, possibly Sewell horizon	6	406
First Salt sand	200	606
Slate 10' / Sand 50 / Slate 40	100	706

	Thickness Feet.	Total Feet.
Second Salt sand	255	961
Slate	2	963
Sand, white	50	1013
Sand, blue	50	1063
Big Lime	300	1363
Red rock	50	1413
Sand, coarse, Big Injun	187	1600
Sand, Squaw	252	1852
Black slate	75	1927
Blue slate	423	2350
Shelly and "greasy" to bottom	100	2450

This well begins about 40 feet under the No. 2 Gas coal, so the coal encountered at 400 feet is possibly the Sewell bed. No Berea sand was found in the well.

Tompkins No. 1 Well Record (674).

Located in Malden district on Burning Spring branch of Kanawha river, ½ mile northeast of Washington Spring. Authority, C. T. Meyers. Completed, August, 1912. Elevation 760' A. T. B.

	Thickness Feet.	Total Feet.
Drift	64	64
Lime	10	74
Sand	92	166
Slate and lime	74	240
Slate	35	275
Sand	195	470
Slate and lime	30	500
Sand	205	705
Black shale and coal	5	710
Lime	5	715
Sand	269	984
Slate and lime	8	992
Lime	34	1026
Slate	5	1031
Big Lime	122	1153
Sand, Big Injun	27	1180
Lime	46	1226
Red Lime	44	1270
Slate, lime and shells to bottom	1142	2412

Dry hole; well abandoned.

The well is located 1.3 miles north of the Warfield anticline, and the Big Injun sand appears to be broken up at this point.

Prospective Oil and Gas Territory, Malden District.

As shown on the structural map very little drilling for oil and gas has yet been done in Malden district. There is, however, a large acreage within its boundary that the structural map indicates, favorable for oil and gas. (1) Along the crest of the Warfield anticline, north of Eight station, there is a strong probability of gas wells in the Big Injun and Squaw sands. Here the Warfield anticline noses out, and the strata are not broken as is the case where the Warfield anticline crosses the Kanawha river, at which point the gas has been escaping for ages. (2) South of Campbell creek and west of Putney, there are good structural indications for oil if the lower sands are not broken up.

CHAPTER XI.

COAL.

A general discussion has already been given of the geology, structure and character of the coal beds in Kanawha county in preceding pages of this report. The purpose of this chapter is to give a more detailed discussion of the thickness of the beds, the chemical composition, and character of the commercial coals, as well as their probable available area in the county.

STATISTICS OF COAL PRODUCTION.

Coal was mined in Kanawha county as early as 1817, when John P. Turner of New York came to the Kanawha valley in 1815 from the mining regions of Pennsylvania and opened a coal mine at the mouth of Burning Spring Branch (Washington Spring) in possibly the No. 2 Gas coal seam, and entered into a contract to supply coal as fuel to one of the salt furnaces. Coal was soon adopted as fuel by other salt furnaces, and thus coal mining became an industry in Kanawha county.

Prof. W. B. Rogers made an examination of the coal seams of the Great Kanawha about 1836, and in 1841 a geological survey was made under his directions, and in his report he states he examined five seams of bituminous coal and two seams of cannel coal, above water level, in the Great Kanawha valley. He further stated that for the year 1840, 5,000,000 bushels of coal were mined and used for the production of 1,000,000 bushels of salt. Possibly the first coal shipped from Kanawha county was mined by Alva Hansford who, in 1840, built a boat, loaded it with coal and transported it to Cincinnati, where he sold the coal at the rate of seven cents per bushel.

In 1840 the quantity of bituminous coal mined in Western Virginia (now West Virginia) was computed to be 289,698 gross tons, while the entire state of Virginia produced 379,369 gross tons.

It was not until about the year 1849, and thereafter, that a systematic exploration of the mountains and hills of the Great Kanawha Valley was undertaken with a view of determining the value of the same as a coal producing field. At that time Colonel William H. Edwards, owner of the Wilson Survey of 85,600 acres, began to make extensive investigations in search of coal.

In the year 1853 mines were opened on Fields creek, where the Winifrede Collieries are now located, and the coal transported to the Kanawha River by narrow gauge railway and thence shipped to Cincinnati, and the lower Ohio by flat boats.

The year 1855 witnessed the first commercial shipments of coal from Kanawha county, though there were many coal companies organized at this time to commence the development of coal lands. From an issue of the **Independent Republican** of Point Pleasant, Mason County, Virginia (now West Virginia), dated October 4th, 1855, we read the following:

"COAL CONVENTION—Proceedings of a Convention held at Charleston, Kanawha county, pursuant to notice, on the 15th of September, 1855.

Representatives Present:

Col. C. Q. Tompkins, Representative of the Paint Creek Co.
H. M. Onderdonk, Great Western Mining & Manufacturing Co.
E. Kenna, Forks of Coal Company.
S. F. Griffin, Mt. Carbon Coal Co., and Wyoming Coal Co.
Dr. English, Mithcomah Cannel Coal Co.
P. P. Doddridge, Old Dominion Coal Co., and the Kanawha Coal Co.
Joseph Gill, Coal River and Kanawha Mining and Manufacturing Co.
W. T. Rosencrans, Cannel Coal Company of Coal River.
J. D. Vanhorn, Western Mining & Manufacturing Company of Coal River.
Clement Smith, President of Coal River Navigation Company.
N. Fitzhugh, Pioneer Coal Company.
Clement Smith, Virginia Cannel Coal Company of Peytonia, Coal River.
W. J. Rand, Iron Hills Coal Company.
Samuel Miller, Kanawha Salt Company.

"The meeting being duly organized, Colonel C. Q. Tompkins was called to the chair, who briefly stated that the object of the Convention was to elicit information appertaining to the mineral and other interests of the Great Kanawha Region, with the view of preparing a

report, exhibiting the claims of those interests to the legislative aid of the State.

"Some interesting remarks were made by different members of the Convention, and the following resolutions were presented to and passed by the Convention unanimously:

"Resolved, 'That Colonel C. Q. Tompkins, Messrs. Clement Smith, S. F. Griffin and Samuel A. Miller, be, and they are hereby appointed a committee, whose duties it shall be to inquire into the extent of the general resources of the Valley of the Kanawha; the probable amount and value of the freight it will furnish for transportation; the extent of the interests now engaged in the coal, iron, salt and lumber of the valley; the necessity of an improved mode of transportation to secure a successful development of those and other interests; to propose a Memorial to the Legislature, embodying the result of their inquiries in the matters thus submitted to them, and to do and perform every other act and thing which they think will best subserve the interests of the parties composing this meeting, having a proper regard to the great interests of the State, as well as the rights and interests of the James River and Kanawha Company.

"Resolved, 'That this meeting be adjourned to meet at Charleston on the 15th day of November next, and if the meeting shall not then convene, that the Committee, appointed by the preceding resolution, shall, and they are hereby requested to lay the Memorial to be prepared by them, before the Legislature in such manner as the Committee may deem most appropriate.

"Resolved, 'That the proceedings of this meeting be published in the Kanawha Republican, and that the other papers of the State, friendly to the improvements contemplated, be requested to publish the same.'

(Signed) COL. C. Q. TOMPKINS, President.
(Signed) CLEMENT SMITH, Secretary."

When the salt manufacturing began to decrease, the manufacturers had coal lands, but they did not have the necessary capital to develop the mines, build barges and boats or purchase railway equipment, and for this reason they were applying to the State Legislature for aid.

In 1866, Professor Harris S. Daddow, of Pottsville, Pa., published his exhaustive work, "Coal, Iron and Oil," in which he says:

"The coals of the Great Kanawha Region, as we shall specially describe, are of various constituencies, and are adapted to all the requirements of the trades and manufactures. The hard and the coking, with the fat and gaseous bituminous; the variable splint, and the rich and oily cannel, are all found in the same mountains, and are all accessible, alike to the miner and navigation, through the agencies of the eroding waters which have exposed these coals in a thousand places. This is the natural mining and manufacturing center of the Great Allegheny Coal field."

While Kanawha County is rich in its deposits of natural gas, oil and salt, yet its greatest wealth lies in its coal deposits.

The hills contain a great number of seams of coal of a workable thickness.

The following are the seams of coal of commercial thickness in different points of Kanawha county:

The Pittsburgh, Upper Kittanning, Middle Kittanning (No. 5 Block), Lower Kittanning, Stockton-Lewiston, Coalburg, Winifrede, Thacker, Cedar Grove, Peerless, No. 2 Gas, Powellton, Eagle and Little Eagle.

The three following tables have been compiled from the annual report ending June 30, 1912, of John Laing, Chief of the Department of Mines of West Virginia.

Coal Production of Kanawha County from 1888 to 1912 Inclusive.

Year	Tons of 2240 lbs.	Year	Tons of 2240 lbs.
1888	982,310	1901	1,727,115
1889	976,396	1902	1,863.386
1890	1,021,386	1903	1,878,752
1891	1,209,386	1904	2,792,078
1892	1.175,371	1905	3,126,638
1893	1,210,749	1906	4,086,102
1894	1,143,626	1907	4,626,101
1895	1,078,253	1908	4 523,739
1896	1,088,737	1909	4,136,213
1897	1,042,745	1910	5,754,378
1898	1.213,116	1911	5,753,470
1899	1,293,068	1912	5,606,522
1900	1,456,890		
Total			60,766,527

Coke Production of Kanawha County from 1897 to 1912 Inclusive.

Year	Tons 2000 lbs.	Year	Tons 2000 lbs.
1897	20,132	1905	19,993
1898	21,578	1906	31,527
1899	10,983	1907	18,287
1900	32,665	1908	12,124
1901	30,722	1909	.....
1902	29,722	1910	21,908
1903	25,789	1911	5.466
1904	9,547		
Total			290,443

Order of the Counties in the Production of Coal, 1897-1912, Inclusive.

	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Fayette	1	1	1	1	1	1	2	1	2	2	2	2	2	2	2	2
McDowell	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	1
Marion	3	3	3	3	3	3	3	4	3	4	4	4	4	4	4	4
Kanawha	**4**	**4**	**4**	**4**	**4**	**4**	**5**	**3**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Mercer	5	5	5	6	6	6	6	6	6	6	6	6	6	7	8	8
Harrison	9	9	8	7	5	5	4	5	5	5	5	5	5	5	5	6
Tucker	6	6	7	5	7	7	7	8	8	8	10	10	10	10	10	10
Mingo	8	8	9	9	9	8	8	7	7	7	7	7	9	9	9	9
Mineral	7	7	6	8	8	9	11	11	12	13	14	13	11	13	15	17
Preston	13	11	10	10	10	10	9	10	10	9	9	11	13	11	11	11
Taylor	10	10	11	11	11	11	14	16	16	16	17	17	16	15	14	14
Marshall	11	12	12	12	13	16	13	14	14	15	15	18	19	16	18	16
Randolph	....	....	....	14	14	14	12	13	13	12	13	14	14	14	13	13
Barbour	19	19	17	18	12	12	10	9	11	11	11	12	12	12	12	12
Raleigh	16	16	16	19	17	13	15	12	9	10	8	8	8	6	6	5
Putnam	12	13	13	13	15	15	16	15	15	14	18	16	17	17	17	18
Ohio	15	15	14	15	16	17	18	19	21	22	21	21	21	20	20	20
Brooke	17	18	18	20	20	20	23	22	17	17	16	15	15	18	16	15
Mason	14	14	15	16	18	19	19	20	22	21	22	22	22	22	22	25
Grant	....	....	....	....	....	....	22	18	19	19	20	20	20	21	21	23
Logan	....	....	....	....	....	....	....	....	20	18	12	9	7	8	7	7
Monongalia	20	17	19	17	19	18	17	17	18	20	19	19	18	19	19	19
Hancock	18	20	20	21	21	21	30	21	24	24	23	25	26	24	27	....
Clay	....	....	....	....	....	....	....	25	23	23	24	27	30	30	25	24
Nicholas	....	....	....	....	....	22	24	24	25	25	25	26	27	26	24	29
Lincoln	....	....	....	....	....	23	21	23	27	26	30	30	25	28	28	....
Braxton	....	....	....	....	....	....	....	....	....	....	26	23	23	23	23	22
Wayne	....	....	....	....	....	....	....	....	26	27	29	29	28	29	32	28
Upshur	....	....	....	....	....	....	....	....	....	28	27	24	24	25	29	31
Greenbrier	....	....	....	....	....	....	....	....	....	....	28	28	29	32	30	27
Lewis	....	....	....	....	....	....	....	....	....	....	31	31	32	33	33	30
Gilmer	....	....	....	....	....	....	....	....	....	....	32	32	31	31	31	26
Wyoming	....	....	....	....	....	....	....	....	....	....	....	33	34	34	....	....
Boone	....	....	....	....	....	....	....	....	....	....	....	....	33	27	26	21

Production of Coal in Kanawha County for the Year Ending June 30, 1912.

Name of Company.	Name of Mine.	First Six Months.	Second Six Months.	Total Coal Produced For Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mine.
Queen Shoals Coal Co.....	Queen Shoals.....	13,745	8,272	22,017	135	.....	21,882
Morris Fork Coal Co.....	Turner No. 1 & No. 2	19,179	13,844	33,023	893	295	31,835
Clay Coal Company.....	Bradley White Ash.	10,000	10,000	20,000	.....	.....	20,000
Villa Coal Mining Co.....	Mill Creek.....	6,220	2,630	8,850	1,200	500	7,150
Blue Creek Coal & Land Co...	Wills Hollow No. 1 and No. 2.....	.....	6,646	6,646	.....	.....	6,646
Blue Creek Coal & Land Co...	Blakeley No. 3....	17,435	28,190	45,625	584	405	44,636
Standard-Kan. Coal Mine Co...	No. 1.....	20,125	20,607	40,732	1,020	97	39,615
Standard-Kan. Coal Mine Co...	No. 2.....	6,134	6,132	12,266	.....	47	12,219
Williams Coal Company.....	Williams	3,215	7,128	10,343	300	100	9,943
Campbells Creek Coal Co.....	No. 1.....	118,038	116,202	234,240	6,054	5,286	222,900
Campbells Creek Coal Co.....	No. 3.....	35,786	54,047	89,833	1,114	612	88,107
Virginia Coal Company.....	Virginia	14,000	18.000	32,000	700	300	31,000
Quincy Coal Company.....	Quincy No. 2.....	26,347	38,766	55,113	2,000	600	55,513
Sunday Creek Company.....	No. 101.....	40,028	32,766	72,794	1,258	688	70,848
Sunday Creek Company.....	No. 104.....	43,633	46,487	90,120	1,704	839	87,577
Sunday Creek Company.....	No. 105.....	101,839	94,772	196,611	3,387	3,661	189,563
Kelleys Creek Colliery Co.....	No. 1.....	9,490	16,799	26,289	.....	.....	26,289
Kelleys Creek Colliery Co.....	No. 3.....	86,748	86.077	182,825	807	2,944	179,074
Hughes Creek Coal Company...	No. 2 and 3.....	52,337	55,656	107,993	900	400	106,693
Cannelton Coal & Coke Co.....	No. 1 and 2.....	197,213	142,111	339,324	1,800	4,478	333,046
Cannelton Coal & Coke Co.....	No. 4.....	.....	1.786	1,786	.....	.....	1,786
Marmet Coal Company.....	Monarch No. 1 & 2.	42,587	33,789	76,376	3,259	1,024	72,093
Coopers Creek Coal Co.....	Peacock	2,200	2,200	4,400	.....	.....	4,400
Marmet Coal Company.....	New Butler.....	17,495	34.807	52,302	2,439	1,640	48,223
Marmet Coal Company.....	Lens Creek.....	16,825	.....	16,825	.....	.....	16,825
Marmet Coal Company.....	Black Band.....	29,375	31,634	61,009	.....	.....	61,009

Name of Company.	Name of Mine.	First Six Months.	Second Six Months.	Total Coal Produced For Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mine.
Olcott Coal & Iron Co.....	Olcott No. 1.....	40,442	35,411	75,853	3,000	545	72,308
Olcott Coal & Iron Co.....	Olcott No. 2.....	26,865	25,615	52,480	.....	2,002	50,478
Winifrede Coal Company.....	South	46,406	12,204	58,610	2.034	909	55,667
Winifrede Coal Company.....	North	22,942	26,250	49,192	1,768	847	46,577
Winifrede Coal Company.....	West	35,124	29,498	64,622	2,303	1,086	61,233
Dry Branch Coal Company.....	Coalburg and Mr. Bryson	37,106	41.342	78,448	1,160	1,200	76,088
Dry Branch Coal Company.....	Belmont No. 3.....	5,657	5,924	11,581	.....	.....	11,581
Coalburg Colliery Co.....	Ronda	53,000	61,000	114,000	1,200	1,500	111.300
Wyatt Coal Company.....	Oakley	21,045	25,763	46,808	1,200	480	45,128
Wyatt Coal Company.....	Berlin	39.149	45,634	84,783	1,200	980	82,603
Wyatt Coal Company.....	Horton No. 1.....	30,736	29,973	60,709	.....	.....	60,709
Wyatt Coal Company.....	Horton No. 2.....	23,976	23,842	47,818	.....	950	46,868
Lewis Coal & Coke Co.....	Peerless & Lewis-ton	18,972	18,972	37,944	830	26,394	10,720
Persinger Coal Company.....	Wilton	.....	1,841	1,841	.....	.....	1,841
Southern Collieries Co.....	LaMont	.....	12,493	365	100	.....	12,028
Holley & Stephenson C. & C. Co	Stepnenson No. 5..	32,559	39,724	72,283	.....	.....	72.283
Holley & Stephenson C. & C. Co	Stephenson No. 2..	37,210	49,476	86,686	678	802	85,206
Wake Forest Mining Co.....	Wake Forest.....	59,116	57,676	116,792	1,200	1,200	114,392
Carbon Coal Company.....	North Carbon.....	8,267	8,599	16,866	.....	120	16,746
Carbon Coal Company.....	South Carbon.....	11,461	17,266	28,727	2,400	.....	26,327
Carbon Coal Company.....	Carbon Splint.....	40,945	37,834	78,779	.....	240	78,539
Carbon Coal Company.....	Low Sulphur.....	5,288	8,901	14,189	.....	.....	14.189
Republic Coal Company.....	Republic No. 1.....	19,949	19,755	39,704	2,400	.....	37,304
Republic Coal Company.....	Republic No. 2.....	22,973	17,167	40,140	.....	.....	40,140
Republic Coal Company.....	Republic No. 3 & 4.	11,437	27,782	39,219	.....	.....	39,219
Republic Coal Company.....	Republic No. 5.....	674	4,220	4,894	.....	240	4,654

Name of Company.	Name of Mine.	First Six Months.	Second Six Months.	Total Coal Produced For Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mine.
West Virginia Colliery Co.....	W. Va. No. 1.....	50,876	52 519	103,395	2,400	.....	100,995
West Virginia Colliery Co.....	W. Va. No. 2.....	11,429	12,048	23,477	.....	.....	23,477
West Virginia Colliery Co.....	W. Va. Splint No. 3.	60,344	57,314	117,658	.....	240	117,418
West Virginia Colliery Co.....	W. Va. Gas No. 4..	21,285	35 154	56,439	.....	120	56,319
Cabin Creek Cons. Coal Co....	Davis	31,869	37,811	69,680	428	649	68,603
Cabin Creek Cons. Coal Co....	Cherokee	23,668	20,454	44,122	.....	409	43,713
Cabin Creek Cons. Coal Co....	Caledonia	11,228	12 030	23,258	.....	.....	23,258
Cabin Creek Cons. Coal Co....	Red Warrior	14,985	16,141	31,126	1,012	437	29,677
Cabin Creek Cons. Coal Co....	Buckeye	25,507	28,630	54,137	.....	.....	54,137
Cabin Creek Cons. Coal Co....	Empire	17.772	19,533	37,305	.....	.....	37,305
Cabin Creek Cons. Coal Co....	Black Tulip	21,978	27,001	48,979	.....	.....	48,979
Cabin Creek Cons. Coal Co....	Keystone	18,850	18,880	37,730	2,053	.....	35,677
Cabin Creek Cons. Coal Co....	Acme	20,530	17.964	38,494	.....	1,554	36,940
Cabin Creek Cons. Coal Co....	Shamrock	33,470	38,120	71,590	.....	.....	71,590
Cabin Creek Cons. Coal Co....	Thistle	26,191	27,994	54,185	.....	.....	54,185
Cabin Creek Cons. Coal Co....	Raccoon Gas	23,836	22 394	46,230	.....	172	46,058
Cabin Creek Cons. Coal Co....	Raccoon Splint, East & West ...	34,445	60,458	94,903	.....	1,094	93,809
Cabin Creek Cons. Coal Co....	Rose	41,438	36,820	78,258	.....	.....	78,258
Cabin Creek Cons. Coal Co....	Kayford No. 1 & 2..	56.763	63,765	120,528	4,657	2,908	112,963
Cabin Creek Cons. Coal Co....	Holly	18,203	13,789	32,091	.....	290	31,801
Cabin Creek Cons. Coal Co....	Quarrier	26,664	29.726	56,390	1,718	377	54,295
Cabin Creek Cons. Coal Co....	United Gas	59,270	49,904	109,174	1,314	.....	107,860
Cabin Creek Cons. Coal Co....	United Splint	23,315	25,898	49,213	.....	815	48,398
Cabin Creek Cons. Coal Co....	Belleclare	17 223	22,053	39,276	1,233	13	38,030
Cabin Creek Cons. Coal Co....	Ruby	17,321	17,046	34,367	.....	835	33,532
Paint Creek Collieries Co.....	Reynolds	32,951	43,216	76,167	1,185	354	74,628
Paint Creek Collieries Co.....	Knickerbocker	19,480	23.430	42,910	286	648	41,976

Name of Company.	Name of Mine.	First Six Months.	Second Six Months.	Total Coal Produced For Year.	Used in Operation of Mine.	Furnished Local Trade and Tenants.	Quantity Shipped from Mine.
Paint Creek Collieries Co.....	Scranton	7,579	9,178	16,757	.....	.....	16,757
Paint Creek Collieries Co.....	Paint Creek	40,796	34,973	75,769	1,400	1,283	73,086
Paint Creek Collieries Co.....	Wacomah	12,124	16,034	28,158	1,130	1,255	25,773
Paint Creek Collieries Co.....	Banner Nos. 1 and 2	20,955	14,721	35,676	110	240	35,326
Paint Creek Collieries Co.....	Detroit	9,225	7,313	16,538	260	175	16,103
Paint Creek Collieries Co.....	Morton No. 1.....	4,917	3,127	8,044	.....	.....	8,044
Paint Creek Collieries Co.....	Grose No. 1 & No. 2	23,460	15,616	39,076	1,338	456	37,282
Paint Creek Collieries Co.....	Greenbrier No. 1 & No. 2	17,486	12,803	30,289	.....	213	30,076
Coalburg-Kanawha Coal Co....	Coalburg "A" & "B"	33,526	15,828	49,354	89	343	48,922
Southwestern Splint Fuel Co...	Black Cat	4,358	12,738	17,096	520	46	16,530
Belmont Coal Company.....	Belmont & Cedar Grove	16,614	23,988	40,602	770	664	39,168
Crown Hill-Kanawha Coal Co...	Coalburg No. 8.....	8,000	20,467	28,467	.....	.....	28,467
Standard Splint & Gas Coal Co.	Standard	42,752	35,200	77,952	900	900	76,152
Imperial Colliery Company.....	Imperial No. 1.....	55,600	43,900	99,500	2,400	.....	97,100
Imperial Colliery Company.....	Imperial No. 2 & 3.	52,600	34,800	87,400	.....	2,000	85,400
Chesapeake Mining Company..	Chesapeake No. 1..	49,301	34,528	83,829	1,305	623	81,901
Chesapeake Mining Company..	Chesapeake No. 2 & 3	32,547	25,148	57,695	760	361	56,574
Montgomery Coal Company....	Kanawha	15,894	16,741	32,635	378	381	31,876
Morris Creek Collieries Co.....	Kanawha No. 5 Block	12,800	.....	12,800	300	100	12,400
East Bank Mining Company....	East Bank	1,000	2,000	3,000	75	75	2,850
Totals in tons of 2240 lbs..	.....	2,813,817	2,792,705	5,606,522	79,313	83,541	5,443,668
Totals in tons of 2000 lbs..	.....	3,151,475	3,127,830	6,279,305	88,830	93,566	6,096 908

No coke was manufactured in Kanawha county for the fiscal year ending June 30, 1912.

MINABLE COALS.

There are probably twelve workable coals in Kanawha county in addition to ten seams which are too thin and irregular to have any economic importance. The probable minable beds in descending order are the Pittsburgh, Upper Kittanning, No. 5 Block (Middle and Lower Kittanning), Stockton-Lewiston, Coalburg, Winifrede, Thacker, Cedar Grove, Peerless, No. 2 Gas, Powellton, and Eagle.

The chemical analyses and calorific results, given in this report, were determined by J. Berghuis Krak, Assistant Chemist of the Survey, under the direction of B. H. Hite, Chief Chemist. The same methods of analysis and sampling of the commercial mines were followed as by the Fuel Testing Department of the U. S. Geological Survey.

The calorific value of all coals is expressed in terms of British Thermal Units (B. T. U.). This unit of heat measurement represents the amount of heat required to raise one pound of water one degree Fahrenheit in temperature.

In any analysis, giving the B. T. U. result, the number of units represents the amount of heat stored up in one pound of coal. Along with the proximate and ultimate analysis is given the heat value, both determined by the calorimeter and calculated from the ultimate analysis, as well as the ratio of the total carbon to the oxygen plus ash. The latter ratio is the best yet devised for the classification of coals in order of their relative rank as to heat value.

The commercial coals of the area will now be discussed in descending order.

COAL OF THE MONONGAHELA SERIES.

The Pittsburgh Coal.

The Pittsburgh coal appears to be the only minable bed of the Monongahela series; that is, it is the only vein to attain sufficient thickness, purity and regularity to be figured as an

asset in estimating the economic resources of the county. The crop of this coal is shown by an appropriate symbol on the economic geology map accompanying this report. A detailed description of its character, thickness, and distribution is given on pages 124-126.

The Pittsburgh coal is mined by the farmers in Union and Poca districts for local fuel use, and considerable tonnage is annually transported by wagons through central Putnam, southern Mason and Jackson counties for fuel for the residents living there. Also considerable coal is transported by wagon to Charleston, where it is sold for local fuel and steam coal.

JEFFERSON DISTRICT.

The Pittsburgh coal occurs in the highest points south of Saint Albans, where the coal has been mined for local fuel use.

Wm. Taylor Opening—No. 1 on Map.

	Thickness. Ft.	In.
Sandstone.		
Slate	2 to 3	
Coal, hard block	4	3
Fire clay floor. Elev. 1025' A. T. B.		

UNION DISTRICT.

The Pittsburgh coal crops on the highest hills in the southern portion of Union district, and goes under the surface in the northern part of this district.

James Thacker Opening. No. 2 on Map.

Located in Union district, 1.8 miles northeast of Lock Seven.

	Thickness Ft.	In.
Slaty shale roof	0	10
Coal, block	0	11
Coal, soft	0	6
Fire clay floor		
Total coal	1	5

The opening has been driven under cover 60 feet.

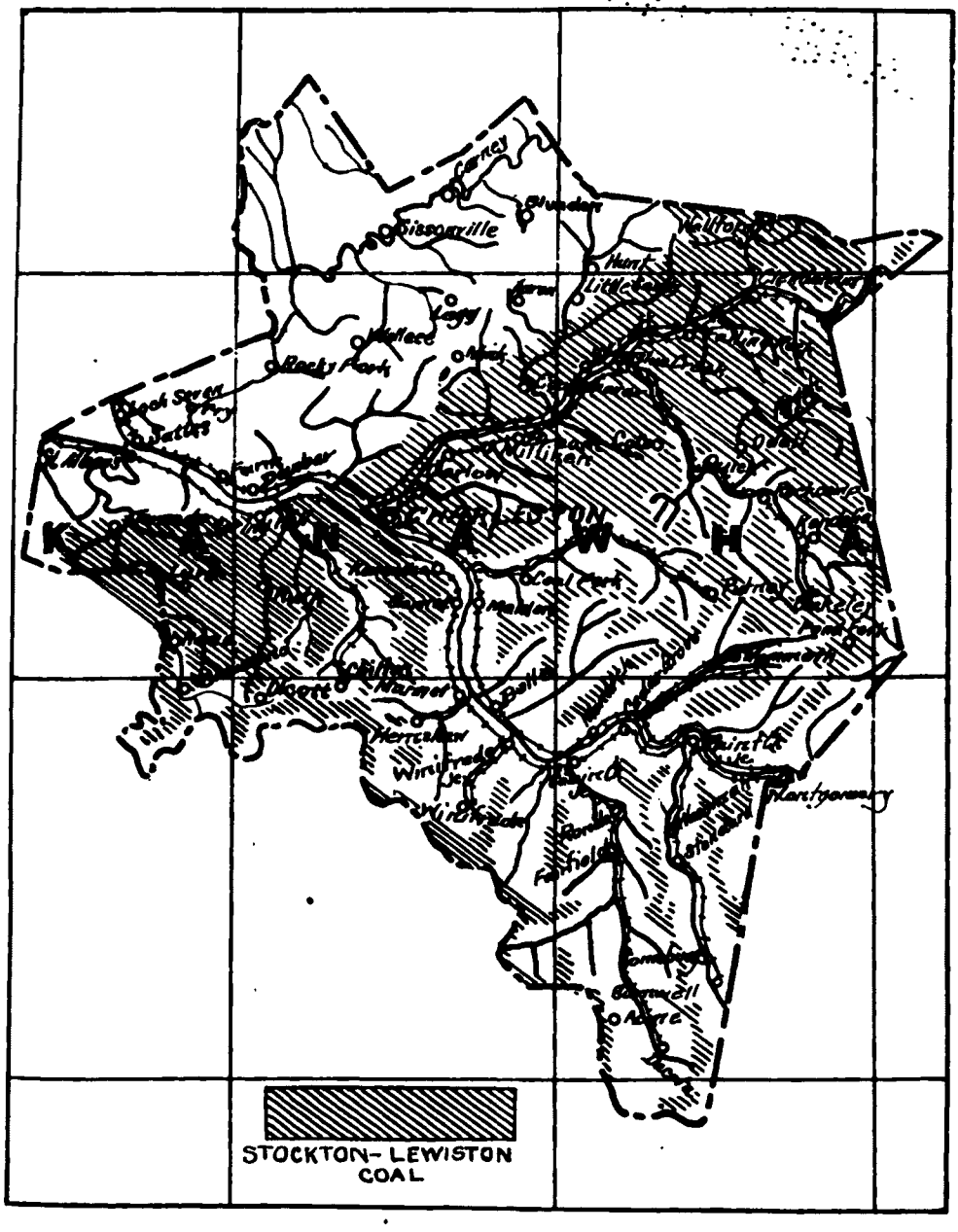


Fig. 14—Showing Approximate Area of Available Stockton-Lewiston Coal in Kanawha County.

YALE LIBRARY

Charles Oyler Opening.—No. 3 on Map.

Located in Union district, on waters of Rocky Fork, 3 miles north from Farm.

	Thickness Ft.	In.
Slate roof	..	...
Coal, medium hard	4	1
Coal, soft	1	0
Fire clay floor	..	...
Total coal	5	1

Mr. Oyler mines 10,000 to 15,000 bushels of coal per annum.

Joseph Roberts Opening.—No. 4 on Map.

Located in Union district, on waters of Rocky Fork, ¾ mile southeast of Rocky Fork P. O.:

	Thickness Ft.	In.
Shale and sandstone	..	...
Slate roof	..	...
Coal, block	4	9

Firt clay floor; Elev. 910' A. T. B.

The coal is mined here for local fuel use.

J. S. Bufford Opening.—No. 5 on Map.

Located in Union district, on Rocky Fork, at mouth of Limestone Branch.

	Thickness Ft.	In.			
Sandstone, massive	..	...			
Slate roof	0	5			
Roof coal	1	0			
Coal, block	2	1	....	6'	4"
Bone	0	1			
Coal, good	3	2			

The coal is mined here for local use.

Conley Brothers Opening.—No. 6 on Map.

Located in Pocatalico district, Putnam county, 1 mile east of Lanham P. O. and ¼ mile west of the Kanawha-Putnam county line.

	Thickness Ft.	In.			
Coal	0	1			
Slate	0	3	....	6'	1"
Coal, Elev, 820' L	5	9			

H. A. Haynes Opening.—No. 7 on Map.

Located in Union district, on Rich Fork of Two Mile creek, 2½ miles northeast of Guthrie P. O.

	Thickness Ft.	In.		
Slate	1	0		
Roof coal	0	8		
Bone	0	2		
Coal, block, good	3	2	....	7′ 11″
Bone	0	1		
Coal, soft	3	10		
Fire clay floor	..	...		

Mr. Haynes mines about 20,000 to 25,000 bushels of this coal annually, and hauls same in wagons to Charleston, where he finds ready sale for same, for fuel and steam coal.

U. B. Young Opening.—No. 8 on Map.

Located in Union district on waters of Tuppers creek, 2½ miles northeast of Guthrie P. O.

	Thickness Ft.	In.		
Sandstone, massive	35	0		
Roof coal	0	6		
Clay and shale	0	8		
Coal, good	3	0	....	6′ 4″
Bone	0	2		
Coal, good; Elev. 920′ A. T. B.	2	8		

Alexander Gillespie Opening.—No. 9 on Map.

Located in Union district, on waters of Rocky Fork, 3¼ miles north of Farm.

	Thickness Ft.	In.
Slate roof		
Coal block	5	0
Fire clay floor; Elev. 925′ A. T. B.		

Coal is mined here for local use.

Walter Thomas Opening.—No. 10 on Map.

Located in Union district, 1¾ miles northwest of Guthrie P. O.

	Thickness Ft.	In.		
Coal	0	11		
Slate	0	9		
Coal	0	4	....	5′ 11″
Impure coal	0	6		
Coal, block; Elev. 830′ A. T. B.	3	10		

L. M. Lafollette Opening.—No. 11 on Map.

Located in Union district, on Dutch Hollow, 1.2 miles northwest of Rocky Fork P. O.:

	Thickness Ft.	In.
Sandstone, massive.		
Slate	0	10
Coal	4	0
Fire clay floor. Elev. 860' A. T. B.		

John Haynes Opening.—No. 12 on Map.

Located in Union district, one mile west of Mink P. O. on Copen Branch.

	Thickness Ft.	In.		
Sandstone				
Slate	0	10		
Coal, block	2	0		
Bone	0	2	....	5' 4"
Coal, block. Elev. 920' A. T.	3	2		

Joseph McCutchen Opening.—No. 13 on Map.

Located in Union district, one-half mile southeast of Guthrie P. O.

Sandstone.	Thickness Ft.	In.		
Slate	1	0		
Coal	0	7		
Bone	0	2		
Coal, block	3	0	....	5' 2"
Slate	0	1		
Coal, block	1	4		

Fire clay floor.

The foregoing 12 openings of the Pittsburgh coal in Union district, give an average thickness of 5 ft. 1½ in. coal, excluding slate and bone.

POCA DISTRICT.

Poca district is situated north and east of Union district. The southern part of the district carries the Pittsburgh coal of commercial thickness and purity. The coal is mined at several places for local fuel use.

A. B. Humphrey Opening.—No. 14 on Map.

Located in Poca district, one mile south of Sissonville.

	Thickness Ft.	In.
Slate roof.		
Coal, block. Elev. 830′ A. T. B.....	3	8

From 15,000 to 20,000 bushels of coal are mined annually here and transported in wagons for domestic fuel.

P. S. Reese Opening.—No. 15 on Map.

Located in Poca district, 1.5 miles southeast of Legg P. O.

	Thickness Ft.	In.		
Slate roof.				
Slate	0	6		
Coal, block	3	0		
Bone	0	1	....	6′ 2″
Coal	3	1		

Fire clay floor. Elev. 980′ A. T. B.

Coal is mined here for local fuel use.

Grant Tate Opening.—No. 16 on Map.

Located in Poca district, 2 miles southwest of Legg P. O. on land of Bruin estate.

	Thickness Ft.	In.		
Slate roof.				
Coal	3	5		
Bone	0	1	....	6′ 7″
Coal	3	1		

Fire clay floor. Elev. 1000′ A. T. B.

Paris Robinson Opening.—No. 17 on Map.

Located in Poca district, 2 miles northeast of Wallace P. O.

	Thickness Ft.	In.
Slate roof.		
Coal	5	3

Fire clay floor. Elev. 935′ A. T. B.

Coal is mined here for local fuel use.

C. A. Ray Opening.—No. 18 on Map.

Located in Poca district, 2.2 miles southwest of Sissonville.

	Thickness Ft.	In.
Slate roof.		
Coal, block	4	0
Fire clay floor. Elev. 780' A. T. B.		

The coal has been mined at this point for more than 50 years for local fuel use.

The average thickness of the Pittsburgh bed excluding bone taken from the four openings given on the preceding pages is 5 ft. 1 in. thick.

ELK DISTRICT.

Elk district lies east of Poca district, and contains a very small area of Pittsburgh coal. No openings that could be measured were found in this district, but several abandoned openings occur and in them the coal was reported to be 4 feet thick.

Quantity of Pittsburgh Coal Available.

It is quite a difficult matter even to approximate the available area and tonnage of Pittsburgh coal in Kanawha county, as the bed is irregular in thickness and patchy in its nature. The several sections of the coal given on preceding pages, reveal its thickness where opened by the farmers for domestic fuel and the writer, in estimating the available tonnage, feels safe in assuming an average thickness of 4 feet in Jefferson district, 3 feet in Union and Poca districts, and 3 feet in Elk district.

A careful determination of its area left uneroded, and as shown on the map accompanying this report, has been made with a planimeter by Mr. Teets, the results of which are given in the following table by magisterial districts:

Table Showing Approximate Available Pittsburgh Coal in Kanawha County.

Districts.	Sq. Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Jefferson	0.05	32	5,575,680	223,027
Union	21.00	13,440	2,927,232,000	117,089,280
Poca	23.00	14,740	3,210,372,000	128,414,880
Elk	2.00	1,280	167,270,400	6,690,816
Totals ...	46.05	29,492	6,310,450,080	252,418,003

In arriving at the above results, the writer has assumed a weight of 80 pounds to the cubic foot of coal, or at the rate of 25 cubic feet to the 2000-pound ton. These figures agree with the determination of the Fuel Testing Plant of the U. S. Geological Survey for the weight of the same amount of the Pittsburgh coal.

Owing to the large deposit, purity and availability of the coals along the Kanawha river, south of Charleston, the Pittsburgh coal has not yet been developed in Kanawha county.

The following table gives the comparative calorific value and fuel ratio of the coal in the Pittsburgh bed in Kanawha county:

ANALYSES OF PITTSBURGH COAL IN KANAWHA COUNTY

Under the Heading "Condition of Sample" "A.D."=air dried, and "A.R."=as received.

Opening No. on Map.	Opening.	District.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
3	Chas. Oyler	Union	Pittsburgh	A. R.	1.73	42.67	47.63	0.011	7.97	3.06							
4	Joseph Roberts	Union	Pittsburgh	A. R.	1.72	43.22	49.54	0.012	5.52	1.87							
5	J. S. Bufford	Union	Pittsburgh	A. R.	2.58	38.81	48.92	0.006	9.69	2.30							
6	Conley Bros.	Union	Pittsburgh	A. R.	1.95	43.17	49.66	0.016	5.22	1.76							
7	H. A. Haynes	Union	Pittsburgh	A. R.	1.54	41.62	50.78	0.007	6.06	0.59							
8	U. B. Young	Union	Pittsburgh	A. R.	1.95	39.21	53.56	0.009	5.28	1.07							
9	Alex. Gillespie	Union	Pittsburgh	A. R.	1.81	44.58	46.96	0.012	6.65	2.16							
10	Walter Thomas	Poca	Pittsburgh	A. R.	1.77	42.90	50.90	0.032	4.43	2.18							
12	John Haynes	Poca	Pittsburgh	A. D.	1.51	34.28	58.15	0.073	6.06	1.23	75.45	5.00	10.89	1.37	13722	13281	4.45
12	John Haynes	Poca	Pittsburgh	A. R.	2.77	33.84	57.41	0.072	5.98	1.21	74.49	5.08	11.89	1.35	13546	13111	4.17
14	Ab. Humphreys	Poca	Pittsburgh	A. D.	1.81	38.95	54.21	0.040	5.03	1.66	76.33	4.98	10.76	1.24	13856	13426	4.83
14	Ab. Humphreys	Poca	Pittsburgh	A. R.	3.04	38.46	53.53	0.039	4.97	1.64	75.38	5.06	11.73	1.22	13683	13258	4.51
15	P. S. Reese	Poca	Pittsburgh	A. D.	2.94	33.24	58.46	0.037	5.36	1.50	75.11	5.30	11.30	1.43	13636	13398	4.51
15	P. S. Reese	Poca	Pittsburgh	A. R.	4.13	32.83	57.75	0.036	5.29	1.48	74.20	5.37	12.25	1.41	13479	13235	4.23
16	Bruin Estate	Poca	Pittsburgh	A. D.	1.81	40.50	52.49	0.024	5.20	1.09	76.82	5.33	10.18	1.38	13926	13735	4.99
16	Bruin Estate	Poca	Pittsburgh	A. R.	3.47	39.82	51.60	0.023	5.11	1.07	75.52	5.43	11.51	1.36	13691	13503	4.54
17	Paris Robinson	Poca	Pittsburgh	A. R.	2.31	40.43	49.04	0.006	8.22	3.98							
18	Dr. C. A. Ray	Poca	Pittsburgh	A. D.	1.84	39.82	52.01	0.028	6.33	2.73	74.13	5.03	10.54	1.24	13545	13199	4.39
18	Dr. C. A. Ray	Poca	Pittsburgh	A. R.	2.91	39.39	51.44	0.027	6.26	2.70	73.32	5.09	11.40	1.23	13397	13055	4.15

Page Reference to Detailed Description and Section of Coal Openings and Mines Listed in Preceding Table.
Pittsburgh Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
3	313	Charles Oyler	411
4	311	Joseph Roberts	411
5	315	J. S. Bufford	411
6	317	Conley Brothers	411
7	320	H. A. Haynes	412
8	319	U. B. Young	412
9	312	Alexander Gillespie	412
10	316	Walter Thomas	412
12	20	John Haynes	413
14	22	A. B. Humphrey	414
15	21	P. S. Reese	414
16	19	Bruin Estate	414
17	318	Paris Robinson	414
18	14	Dr. C. A. Ray	415

COALS OF THE CONEMAUGH SERIES.

The Conemaugh series contains five coals in Kanawha county, viz: Little Pittsburgh, Little Clarksburg, Elk Lick, Harlem, and Bakerstown. Their geology, distribution and thickness are discussed in detail in a preceding chapter of this report.

The Little Clarksburg coal attains a minable thickness at one point in Elk district on the head of Leatherwood creek, a section of which is given on page 163, but as very little development has been made it is not possible to calculate the quantity of available coal in the bed.

The Elk Lick coal attains a thickness that can be mined for fuel in Union district, given on page 166 of this volume, but no attempt will be made to calculate the available tonnage of this seam in Kanawha, owing to its irregularity in thickness and lack of development.

The Harlem coal has been mined on Browns creek in Jefferson district. A section of the coal and analysis of same is given on page 173 of this report.

COALS OF THE ALLEGHENY SERIES.

The Allegheny series contains five coal horizons in Kanawha county, viz: Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning (No. 5 Block) and Lower Kittanning. Their geology, distribution and thickness are discussed in detail in a preceding chapter of this report.

The Upper and Lower Freeport coals do not attain to minable thickness in Kanawha county.

The Upper Kittanning has been described on pages 203-4 of this volume. No attempt will be made to calculate the available tonnage in this seam as it is "patchy" and only occurs in a few places in the county.

The No. 5 Block (Middle and Lower Kittanning) Coal.

The No. 5 Block coal is the most important one in the Allegheny series. Measurements of sections of this bed will now be taken up by districts.

In Poca, Union and Jefferson districts, this coal horizon does not come to the surface, and no core drill hole has been sunk to test for the same, but it is more than probable very little coal of commercial value exists in these districts in the Allegheny series. No estimate can be made of the quantity of available coal in the No. 5 bed in these districts, until more definite information is obtained by testing with the core drill.

In Union district, a core test hole (614) was sunk on the Goff property on Martin Branch, to a depth of about 400 feet, according to the report of the owners, but no merchantable coal was found at this depth.

Another core drill hole was put down by the Otto Marmet Coal and Mining Company, Black Betsey Coal and Mining Company, and the Plymouth Coal and Mining Company, on the Right Hand Fork of Pocatalico river, Pocatalico district, Putnam county, two miles and one-half east of Plymouth, and three miles west of the Kanawha-Putnam county line, and published in Detailed County Report of Jackson, Mason and Putnam counties, page 235, to which the reader is referred for details.

That record shows the absence of coal beds of commercial value in the Conemaugh, Allegheny and upper half of the Kanawha series. The identifications given for the several coal horizons in the Allegheny and Kanawha series may not be exact, but the top members of each are most probably correctly placed. Oil and gas well borings put down near this core drill hole give a total thickness of 737 feet for the Pottsville series in this region, and thus about 600 feet of that series remains unpenetrated by the core drill hole, about half of which would belong in the Kanawha series, and the other or lower half in the New River group. Hence the boring did not reach to the level of the Campbells Creek, or **No. 2 Gas seam,** the most persistent member of the Kanawha series of coals, the horizon of which would come 100 to 150 feet lower in the measures. The "Charleston Sandstone" horizon of the United States Geological Survey, which extends from 383′ 9″ to 777′ 9″ has a thickness of 389 feet, and includes, as it does at Charleston, portions of three geologic series; viz., the base of the Conemaugh, all of the Allegheny, and the top member (Homewood) of the Pottsville series, and hence should not be retained in geologic nomenclature, even for the vicinity of Charleston.

The "fossils" in the Lower Ames limestone at 329 feet are not marine but of fresh or brackish water types, while the "fossiliferous" slate and shale in the Kanawha series contain plant remains.

WASHINGTON DISTRICT.

Washington district is located east of Jefferson. The No. 5 Block coal crops in its southern portion.

Brown Opening.—No. 19 on Map.

Located in Washington district on Big Branch of Coal River, one-half mile northeast of Forks of Coal.

	Thickness Ft.	In.
Sandstone	..	..
Coal, block	2	0
Slate floor. Elev. 635′ A. T. B.		

The coal is mined here for local use, by a shaft slope.

Broun Opening.—No. 20 on Map.

Located in Washington district on Coal River, one-half mile north of Sproul. At an old opening the following section was measured:

	Thickness Ft.	In.			
Sandstone	..	..			
Coal	1	2	}		
Slate	0	4	}	2'	10"
Coal	1	4	}		

Slate floor.

Coal was once mined here and shipped down Coal River in boats.

Courtney and Broun Opening.—No. 21 on Map.

Located in Washington district, one-half mile northeast of Brounland.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, block	1	2	}		
Slate	0	3	}	2'	7"
Coal, block. Elev. 790' A. T. B.	1	2	}		

Burrell Keefer Opening.—No. 22 on Map.

Located in Washington district, on Little Barrier Creek, 2 miles northeast of Sproul.

	Thickness Ft.	In.
Bituminous shale	4	0
Cannel slate	3	0
Coal, Bituminous	2	6

Fire clay floor. Elev. 750' L.

The bituminous coal is used for local fuel use.

A sample of the cannel slate was analyzed by J. B. Krak, with the following results:

	Per cent.
Moisture	1.11
Volatile Matter	36.56
Fixed Carbon	36.14
Ash	26.19
Total	100.00
Sulphur	00.48
Phosphorus	.008

LOUDON DISTRICT.

Loudon district is situated east of Washington. The No. **5 Block coal** comes to the surface in the northeast corner of the district on Davis creek, near the mouth of Dry Branch, and also comes above the Chesapeake & Ohio railroad grade just opposite the mouth of Elk river.

The coal dips rapidly from Dry Branch toward the mouth of Davis creek, as the Buffalo sandstone comes to the level of the C. & O. R. R. grade at Spring Hill. A diamond drill hole put down ½ mile south of the C. & O. Ry. along Davis creek, encountered the No. 5 Block coal at 182 feet, according to report of E. B. Dyer of Charleston. The coal was thin and mixed with black slate.

The seam has been mined for local fuel use along Davis creek and the Kanawha river, and was once mined on the hills back of Malden for fuel coal used in the salt furnaces. The Marmet Coal Company, several years ago, mined this seam at Henshaw but has now abandoned the mine.

J. R. Dodson Opening.—No. 23 on Map.

Located in Loudon district on Middle Fork of Davis Creek, 1.6 miles southwest of Ruth P. O., on property of J. H. Huling.

	Thickness Ft.	In.			
Shale roof.					
Coal	0	2			
Fire clay	1	8	....	3′	9″
Coal, block. Elev. 830′ A. T. B.	1	11			

Jas. H. Huling Opening.—No. 24 on Map.

Located in Loudon district on Davis Creek, just below the mouth of Middle Creek.

	Thickness Ft.	In.			
Slate roof.					
Impure coal	0	5			
Coal, hard	0	8			
Bone	0	1½	....	5′	1½″
Coal, splint	0	10			
Impure coal	0	10			
Coal, splint. Elev. 600′ A. T. B.	2	3			

Butts Run, N. 43° west; faces N. 47° east.

The coal is mined here for local fuel use, and is hauled in wagons to Spring Hill and Charleston. About 1500 tons is usually mined monthly.

Jas. H. Ellison Opening.—No. 25 on Map.

Located in Loudon district on Middle Fork of Davis Creek, one mile south of its mouth; owned by J. H. Huling.

	Thickness Ft.	In.			
Slate roof.					
Coal	0	6			
Bone	0	1			
Coal	0	9			
Bone	0	2	....	3′	5″
Coal	0	11			
Slate	0	4			
Coal	0	8			

Slate floor. Elev. 715′ A. T. B.

Peter Bailey Opening.—No. 26 on Map.

Located in Loudon district on Davis Creek, near the mouth of Middle Fork; owned by J. H. Huling.

	Thickness Ft.	In.			
Slate roof.					
Bone	0	2			
Coal	0	6	....	3′	7″
Bone	0	2			
Coal	2	9			

Slate floor. Elev. 600′ A. T. B.

Wm. Means Opening.—No. 27 on Map.

Located in Loudon district on Still Branch, 3 miles south of Charleston.

	Thickness Ft.	In.			
Slate roof.					
Bone	0	2			
Coal, hard, good	2	5			
Gray slate	0	4	....	4′	5″
Coal, hard	0	6			
Coal, impure	1	0			

The coal is mined here for local fuel use.

C. A. Rust Opening.—No. 28 on Map.

Located in Loudon district, 1.5 mile southwest of Garrett P. O.

	Thickness Ft.	In.
Sandstone	..	..
Coal	2	4

Fire clay floor. Elev. 1215' A. T. B.

The coal is mined here by Mr. Rust for local fuel use, and the opening is driven in about 50 feet.

Marmet Opening.—No. 29 on Map.

Located in Loudon district, one-half mile southeast from Hernshaw. The coal was once mined at this point and shipped to southern and western markets.

	Thickness Ft.	In.		
Slate roof.				
Coal, impure	1	6		
Slate	0	2		
Coal, impure	1	6		
Slate	1	1½		
Coal, impure	0	2		
Slate	0	3	....	6' 4"
Coal, block, good	1	9		
Slate	0	1		
Coal, block	2	0		
Slate	0	½		
Coal	0	1		

Slate floor; Elev. 1396' A. T. B.

The coal appears to maintain a persistent place in the series in Loudon district, as shown from the sections given, and will yield a considerable quantity of available coal tonnage.

CHARLESTON DISTRICT.

Charleston district lies north of Loudon district. The **No. 5 Block coal** crops above the surface in the district south of Elk river. It is exposed in the road leading from mouth of Ruffner hollow, toward Hill Crest Sanitorium, where it is 2 feet thick.

It was once mined on the land of J. B. Floyd, along Wilson Branch, for domestic use, but is now abandoned.

John B. Floyd Opening.—No. 30 on Map.

Located in Charleston district on Wilson Branch.

	Thickness Ft.	In.			
Slate roof.					
Coal	1	2			
Slate	0	1	....	2'	3"
Coal	1	0			

Slate floor. Elev. 870' A. T. B.

The opening is 110 feet above the Kanawha Black Flint at this point.

ELK DISTRICT.

Elk district lies north of Charleston and east of Poca districts on both sides of Elk river. It contains a larger acreage of **No. 5 Block coal** than any other district in Kanawha county. This coal crops above the surface in the district south of Elk river and along same to a point one-half mile east of the mouth of Indian creek, where it goes under Elk river. It also crops along Coopers creek north of Elk river for a distance of about one mile north of Elk river.

G. A. MacQueen Opening.—No. 31 on Map.

Located in Elk district, on north side of Elk River, one-half mile below mouth of Coopers Creek.

	Thickness Ft.	In.			
Slate roof.					
Impure coal	0	4			
Coal, hard, block	1	6			
Slate	0	3	....	3'	8"
Coal	0	6			
Slate	0	6			
Coal, bone	0	7			

Fire clay floor. Elev. 632' L.

The coal is mined here for local fuel use.

Along Coopers creek to mouth of Mile Branch, the **No. 5 Block coal** outcrops on each side of the stream. It is mined at the mouth of Mile Branch by J. W. Edens.

J. W. Edens Opening.—No. 32 on Map.

		Thickness Ft.	In.			
	Sandstone roof.					
1.	Slate roof	3	0			
2.	Coal, hard, block	2	10	....	5′	5″
	Slate	0	6			
	Coal	0	10			
	Slate	0	6			
	Coal, soft	0	9			
3.	Sandstone and concealed	8	0			
4.	Slate	0	2			
5.	Coal	1	2	....	2′	0″
	Slate	0	2			
	Coal. Elev. 588′ A. T. L.	0	8			

No. 5 is a "split" from the main No. 5 Block coal above, by the swelling of the slate interval which is frequently only 1 to 2 feet thick, and both seams appear to represent collectively the **Middle** and **Lower Kittanning beds.**

The coal has been mined from each seam, but Mr. Edens is now mining coal for local use from the No. 5 Block seam.

Copenhaver and Massie Opening.—No. 33 on Map.
(Now Cooper Coal Company.)

Located in Elk district, on north side of Elk river at Big Chimney.

	Thickness Ft.	In.			
Slate roof.					
Coal .....2′ to	4				
Slate and sandstone	13	0			
Coal, hard, block	1	6	....	3′	6″
Slate	0	6			
Coal, soft	1	6			
Slate floor. Elev. 600′ A. T. B.					

The lower part of this bed is mined for local fuel use.

Riley Botkin Opening.—No. 34 on Map.

Located in Elk district, on Coopers creek, just above mouth of Mile Branch.

	Thickness Ft.	In.
Sandstone, massive	..	..
Shale	3	0

	Thickness Ft.	In.		
Coal, block	2	9		
Fire clay	0	4		
Coal	0	5	....	5′ 1″
Fire clay	0	6		
Coal	0	7		

The coal is mined here for local fuel use.

The No. 5 Block coal has been mined and shipped as domestic coal and general fuel for many years at Bream by various companies. The coal where mined appears to be patchy, containng "rolls." The following section was measured here in the mine operated by the Penmar Mining Company of Charleston.

Penmar Mining Company Opening.—No. 35 on Map.

Located in Elk district on north side of Elk River at Bream.

	Thickness Ft.	In.		
Slate roof, good.				
Coal, hard, block	2	8		
Slate, gray	0	2		
Slate, blue	0	5	....	4′ 3″
Slate, gray	0	5		
Coal, soft	0	7		
Slate floor. Elev. 660′ A. T. B.				

The company has a daily output of 50 tons.

The Cespe-Kanawha Coal Co. Opening.—No. 36 on Map.

Located in Elk district on north side of Elk River at Bream.

	Thickness Ft.	In.		
Slate roof	..	..		
Coal	2	10		
Slate	..	10	....	4′ 2″
Coal	1	6		
Coal blossom; Elev. 650′ A. T. B.	2	0		

The company is mining from 100 to 150 tons of coal per day.

At Coonskin Branch of Elk, about 0.3 mile from the river, three separate coals at the horizon of No. 5 Block, crop out in the following section.

	Thickness Ft.	In.
Sandstone, massive	15	0
Coal blossom	3	0
Sandy shale	7	0
Coal blossom	1	6
Sandy shale	5	0
Coal blossom. Elev. 650' A. T. B.		

Sidney Nelson Opening.—No. 37 on Map.

Located in Elk district on south side of Elk River, one-half mile east of Bream.

	Thickness Ft.	In.		
Sandstone roof.				
Coal, block	2	11		
Slate	0	6		
Coal	0	7	....	5' 10"
Slate	0	4		
Coal	1	6		
Slate floor. Elev. 640' A. T. B.				

The coal is mined here for local fuel use.

On Mill creek, 1.7 miles southwest of Big Chimney, and 1.9 miles northwest of Rutledge, J. M. Henson is mining the No. 5 Block coal for fuel use:

J. M. Henson Opening.—No. 38 on Map.

Located in Elk district on Mill Creek, 1.9 miles northwest from Rutledge P. O.

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Coal, block	0	11		
Impure coal	0	8	....	6' 8"
Fire clay and slate	4	3		
Coal, soft. Elev. 685' A. T. B.	0	10		

Villa Mining Coal Company Opening.—No. 39 on Map.

Located in Elk district on Mill Creek at Villa P. O.

	Thickness Ft.	In.		
Shale roof.				
Coal, Cannel, glossy black	2	2		
Coal, Cannel, birds-eye	1	4	....	4' 7"
Shale, bituminous	0	2		
Coal. Cannel, glossy block	0	11		

Below the cannel bed come about 20 feet of sandy shale and sandstone to a coal blossom which is possibly a lower division of No. 5 Block with the intervening rocks greatly thickened.

Blue Creek Coal & Land Company Opening.—No. 40 on Map.

Located in Elk district on waters of Falling Rock Creek, 4.8 miles southeast of Weir P. O.

		Thickness Ft.	In.			
1.	Sandstone, massive	..	..			
2.	Coal, block	0	10			
3.	Bone	0	4			
4.	Coal, bone	0	6			
5.	Coal, impure	0	8	....	3'	10"
6.	Coal, splint	0	8			
7.	Bone	0	3			
8.	Coal, hard	0	7			

Fire clay floor. Elev. 870' A. T. B.
Samples taken for analysis from Nos. 2, 4, 5, 6 and 8.

The coal is mined for local fuel use at this point.

The No. 5 Block coal comes out of Blue creek a short distance south of the mouth of Mile Branch and is mined at many points along Blue creek in a commercial way on up to the head of the creek at Blakeley:

J. V. Skinner Opening.—No. 41 on Map.

Located in Elk district on Right Fork of Upper Three-Mile Creek.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slaty shale	5	0			
Coal, block	1	1			
Slate	0	2	....	3'	10"
Coal, block	2	7			

Fire clay floor. Elev. 675' A. T. B.

The coal is mined here for local use.

Cedar Run Colliery Company Opening.—No. 42 on Map.

Located in Elk district at mouth of Billy Branch. The coal was once mined here on a commercial scale.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, medium hard	2	1			
Slate	0	½			
Coal, hard, block	1	2	....	4'	0½"
Slate	0	1			
Coal, soft. Elev. 765' A. T. L.	0	8			

The Kanawha Black Flint crops directly below this opening, at an elevation of 655 feet A. T. B., thus making an interval between the No. 5 Block coal and the base of the Kanawha Black Flint of 100 feet at this point.

Three miles to the southwest from opening No. 42, the **No. 5 Block coal** is mined for local fuel use, on Indian creek:

Walter Morris Opening.—No. 43 on Map.

Located in Elk district on Indian Creek near the mouth of Turkey Fork, 2 miles southeast of Pinchton P. O.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, soft	0	5			
Slate, dark	1	4			
Coal, soft	0	3	....	4'	4"
Coal, block	0	6			
Coal, soft	1	10			

Fire clay floor. Elev. 720' A. T. B.

Phillips Opening.—No. 44 on Map.

Located in Elk district on Blue Creek at mouth of Laurel Fork, one mile southeast of Coco P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, good	0	11			
Bone	0	4	....	3'	7"
Coal, block	1	8			
Bone. Elev. 915' A. T. B.	0	8			

The coal is 105 feet above the base of the Kanawha Black Flint at this point.

On a branch of Laurel Fork, the **No. 5 Block coal** has been prospected by the Blue Creek Coal & Land Company:

Blue Creek Coal & Land Co. Opening.—No. 45 on Map.

Located in Elk district, on Laurel Fork of Blue creek.

	Thickness Ft.	In.			
Sandstone roof	..	...			
Coal	0	11			
Impure coal	0	6			
Coal, block	1	4			
Slate	0	1			
Coal, hard	0	4	....	4′	2″
Fire clay	0	6			
Coal	0	8			
Bone	0	6			
Coal	0	4			

Fire clay floor; Elev. 840′ A. T. B.

Standard Kanawha Coal Mining Company Opening. No. 46 on Map.

Located in Elk district, on Blue creek, at Roderic P. O.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal	0	4			
Bone	0	2			
Coal, block	3	4	....	4′	6″
Bone	0	4			
Coal	0	4			

Slate floor; Elev. 950′ A. T. B.

The coal is mined and shipped from here on a commercial scale.

Luther Hudling Opening.—No. 47 on Map.

Located in Elk district on White Oak Fork of Blue creek, 2 miles southeast of Quick P. O.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	0	7			
Coal	0	10			
Bone	0	6			
Coal, block	2	4	....	4′	4″
Bone	0	3			
Coal, soft	0	5			

Sandstone floor; Elev. 1040′ A. T. B.

The coal is mined for local fuel.

Williams Coal Company Opening.—No. 48 on Map.

Located in Elk district, on Blue creek at Sanderson station.

	Thickness Ft.	In.		
Sandstone roof	..	..		
Coal	0	11		
Bone	0	3		
Coal, block	3	1	....	5′ 0″
Bone	0	6		
Coal	0	3		

Slate floor; Elev. 990′ A. T.

The coal is mined and shipped on a commercial scale from this mine.

Chas. Huffman Opening.—No. 49 on Map.

Located in Elk district on Shirkey Branch of Blue creek, 1 mile northwest of Sanderson:

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Slate	0	1		
Coal, hard, block	1	1		
Slate	0	3		
Coal, hard	1	8	....	4′ 0″
Slate	0	2		
Coal, block	0	10		

Fire clay floor; Elev. 970′ A. T. B.

The coal is mined for local fuel.

Blue Creek Coal & Land Co. Opening.—No. 50 on Map.

Located in Elk district on Belcher Branch of Morris Fork of Blue creek, 2 miles southeast of Sanderson P. O.:

	Thickness Ft.	In.		
Sandstone roof	..	..		
Coal	2	0		
Slate	0	2	....	4′ 0″
Coal	1	10		

Slate floor; Elev. 1090′ A. T. B.

The coal is mined here for local use.

Blue Creek Coal & Land Company Opening.—No. 51 on Map.

Located in Elk district, on Mud Lick Branch of Morris Fork, 1.5 miles southwest of Sanderson P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	1	2			
Bone	0	2	....	3′	6″
Coal, block; Elev. 1100′ A. T. B.	2	2			

Thomas Hudnall Opening.—No. 52 on Map.

Located in Elk district, on Morris Fork of Blue creek, 3 miles northeast of Putney:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, block	1	6			
Bone	0	6	....	5′	0″
Coal, good	3	0			

Fire clay floor; Elev. 1115′ A. T. B.

The coal is mined here for local use.

Jos. Stricklin Opening.—No. 53 on Map.

Located in Elk district, on Blue creek, 1 mile east from Sanderson P. O.:

	Thickness Ft.	In.			
Sandy shale	..	..			
Slate	1	2			
Coal	0	10			
Bone	0	2			
Coal	1	1	....	4′	2″
Bone	0	4			
Coal	1	9			

Fire clay floor; Elev. 1030′ A. T. B.

The coal is mined for local fuel here.

On the Right Fork of Laurel run of Blue creek several openings have been made in the No. 5 Block coal, where the bed has the following type:

R. G. Rector Opening.—No. 54 on Map.

Located in Elk district, on Right Fork of Laurel run, 1.7 miles south of Kendalia P. O.:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal	0	1			
Shale, dark	0	1			
Coal	0	5			
Slate, gray	0	½			
Coal	0	6	....	4′	5½″
Slate, gray, bony	0	3			
Coal	0	11			
Fire clay and shale	1	5			
Coal; Elev. 1170′ A. T. B	0	9			

On Middle Fork of Blue creek several openings have been made to test the No. 5 Block coal, as follows:

J. B. Moore Opening.—No. 55 on Map.

Located in Elk district, on Middle Fork of Blue creek, 2 miles northeast of Spangler P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, block	3	0	....	4′	0″
Coal, cannel	1	0			

Fire clay floor; Elev. 1275′ A. T. B

The coal has been mined here for local fuel use. This opening comes 190 feet over the Kanawha Black Flint, which crops in the branch below the opening.

George Dillard Opening.—No. 56 on Map.

Located in Elk district, on west side of Spruce Fork of Blue creek, 1.7 miles southeast of Pond Fork P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	0	6			
Bone	0	4			
Coal	0	11	....	4′	0″
Bone	0	1			
Coal, block	2	2			

Sandstone floor.

The coal is mined for local fuel use by Preston Proctor, a short distance north of the Dillard opening, where the following section was measured:

Preston Proctor Opening.—No. 57 on Map.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	0	2			
Coal	0	8			
Bone	0	4	....	3′	6″
Coal, gray, splint	2	6			

Sandstone floor; Elev. 1230′ A. T. B.

The coal is also mined for local use on the Right Fork of Spruce Fork by John Beard:

John Beard Opening.—No. 58 on Map.

Located in the head of Right fork of Spruce fork of Middle fork of Blue creek, 1 mile northeast of Spangler P. O.:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, soft	0	6			
Bone	0	4	....	4′	3″
Coal, block	2	2			
Coal, soft	0	3			
Coal, block; Elev. 1285′ A. T. B.	1	0			

On the extreme head of Spangler fork the coal is mined for local fuel by Jefferson Johnson, and there the following section was measured:

Jefferson Johnson Opening.—No. 59 on Map.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	0	10			
Bone	0	3			
Coal	0	6	....	4′	5″
Bone	0	2			
Coal, block; Elev. 1280′ A. T. B.	2	8			

The No. 5 Block coal is mined on a commercial scale by the Blue Creek Coal & Land Company at Blakeley, where the following section was measured in Mine No. 1:

Blue Creek C. & L. Co. (Blakeley Mine) Opening. No. 60 on Map.

Located in Elk district, at Blakeley P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Draw slate	0	10			
Coal, splint	0	11½			
Bone	0	4			
Coal	0	9	....	4′	10″
Bone	0	1			
Coal, gas	0	3			
Coal, block; Elev. 1330′ A. T. B.	2	5½			

Butts run S 60° E; Faces N 30° E; greatest rise S 35° E; Capacity, 400 tons daily.

Blue Creek C. & L. Co. (Wills Hollow Mine) Opening. No. 61 on Map.

Located in Elk district, on Blue creek, 1 mile north of Blakeley:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	0	3			
Bone	0	4			
Coal, splint	1	2	....	4′	6″
Coal, gray splint	0	1			
Coal, block	2	8			

Slate floor.

Butts run S 60° E; Faces N 30° W; greatest rise, S 35° E.

The coal is mined and shipped on a commercial scale from this mine.

R. C. Hill Opening.—No. 62 on Map.

Located in Elk district, on the head of Pond Fork of Blue creek, 0.8 mile south of Blakeley P. O. and 0.3 mile north of the Cabin-Elk district line:

	Thickness Ft.	In.
Sandstone roof	..	..
Slate, draw	1	0

	Thickness Ft.	In.			
Coal	0	6			
Bone	0	5			
Coal	0	10	....	4'	5"
Bone	0	1			
Coal, soft	0	4			
Coal, block	2	3			

The coal is mined for local fuel here, the entry being driven about 120 feet under the surface.

BIG SANDY DISTRICT.

Big Sandy district lies north and east of Elk district and in the northeastern part of Kanawha county. **The No. 5 Block coal** comes out of Elk river, just west of Clendenin, and rising rapidly to the east, at Queen Shoals, 4 miles above, the coal is more than 200 feet above the level of the river.

The coal was once mined, at the eastern edge of Clendenin, by L. V. Koontz and brothers, but the mine is now abandoned. The following section was measured in this mine by Ray V. Hennen, and published in Vol. II(A), page 335 of the West Virginia Geological Survey, 1908:

L. V. Koontz & Bros. Opening.—No. 63 on Map.

	Thickness Ft.	In.			
Slate, black, good roof	..	..			
Coal, splint, bright	1	0			
Slate, 2 to 5"	0	3	....	3'	3"
Coal, splint, bright; Elev. 650' A. T. B...	2	0			
Slate and sandstone, massive.					

A. A. Gandy Opening.—No. 64 on Map.

Located in Big Sandy district, on north side of Elk river, ½ mile east of Clendenin:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	0	8			
Bone	0	2	....	3'	8"
Coal, hard, block	2	10			

Slate floor. Elev. 665' A. T. B.

Butts Run N. 29° E.; faces 51° E. The coal is mined for local use, and the output is 10,000 to 13,000 bushels annually.

M. A. Cobb Opening.—No. 65 on Map.

Located in Big Sandy district, one mile east from Clendenin.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	3	0			
Coal	0	6			
Bone	0	1			
Coal, hard, block	0	8	....	3′	4″
Bone	0	3			
Coal	1	10			

Slate floor. Elev. 680′ A. T. B.

The coal is mined for local use.

Brawley Heirs Opening.—No. 66 on Map.

Located in Big Sandy district, on north side of Elk river, one-half mile northeast of Turner.

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	0	4			
Slate	0	1			
Coal	1	0	....	3′	4″
Bone	0	1			
Coal	1	10			

Slate floor. Elev. 775′ A. T. B.

The coal is mined for local use.

This coal is mined by the Claybrook Mining Company on the north side of Elk river, between Queen Shoals and mouth of Barren creek, being transported across the river in buckets on an aerial tramway and loaded into railroad cars at Barren Creek station:

Claybrook Mining Company Opening.—No. 67 on Map.

Located in Big Sandy district on north side of Elk River at Barren Creek P. O.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	1	6			
Bone	0	2	....	4′	0″
Coal, block	2	4			

Fire clay floor. Elev. 790′ A. T. B.

The capacity of the mine is 100 to 200 tons per day.

John Tawney Opening.—No. 68 on Map.

Located in Big Sandy district on a branch of Barren Creek, 1.6 miles northwest of Porter station:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	2	0			
Coal, soft	0	10	}	3'	2"
Bone	0	2			
Coal, hard, block. Elev. 765' A. T. B.	2	2			

The coal is mined for local use.

The Queen Shoals Coal Company mines the **No. 5 Block** coal one-half mile west of Queen Shoals station:

Queen Shoals Coal Company Mine No. 1.—No. 69 on Map.

Located in Big Sandy district, on south side of Elk River, one-half mile west of Queen Shoals station:

	Thickness Ft.	In.			
Slate	5	0			
Coal, block	1	6	}	4'	3"
Slate, gray, hard	0	1			
Coal, hard, block	2	8			

Fire clay floor. Elev. 770' A. T. B.

The mine has a capacity of about 100 tons daily, and furnishes fuel coal for the Coal & Coke Railway's locomotives.

A layer of slaty Cannel coal, especially when approaching a "roll", often appears in the bottom of the coal at this mine. A sample of it was collected by Mr. Hennen, which yielded the following results, as reported by Hite and Patton and published in Vol. II(A), page 531, West Virginia Geological Survey, 1908.

Proximate.

	Per Cent.
Moisture	0.70
Volatile matter	39.35
Fixed carbon	46.02
Ash	13.93
Total	100.00
Sulphur	0.80
Phosphorus	0.007

Calorimeter B. T. U. 13,073
Calculated B. T. U. 12,763

Ultimate.

	Per Cent.
Carbon	71.50
Hydrogen	4.75
Oxygen	7.78
Nitrogen	1.24
Sulphur	0.80
Ash	13.93
Total	100.00

Queen Shoals Coal Company Mine No. 2.—No. 70 on Map.

Located in Big Sandy district, on Queen Shoals Creek, one-fourth mile south of Queen Shoals station and on the Kanawha-Clay county line.

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, block	1	7
Slate	0	2
Coal, hard block	2	7
Fire clay floor. Elev. 865' A. T. B.		
Total coal	4	2

The base of the **No. 5 Block coal** at this point, is 196 feet, spirit level, above the base of the Kanawha Black Flint which appears in the creek under the opening.

Morris Fork Coal Company.—No. 71 on Map.

Located in Big Sandy district on Morris Creek, one mile southeast of Queen Shoals mine No. 2, and known as Turner Mines Nos. 1 and 2. Measurements in mine No. 1 show the following section:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, block	1	6	}	4'	0"
Slate	0	4			
Coal	2	2			

Slate floor. Elev. 745' A. T. B.

King Land Company Opening.—No. 72 on Map.

Located in Big Sandy district, on Burke Branch, 1.1 mile southeast from Clendenin:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Impure coal	0	3	}	2'	4"
Coal, hard, block	2	1			

Slate floor. Elev. 730' A. T. B.

The coal has been mined here for local use.

King Land Company Opening.—No. 73 on Map.

Located in Big Sandy on Morris Creek, 2.3 miles south of Turner station:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, hard, block	1	7	}	3′	2″
Slate	0	1			
Coal, block	1	6			

Slate floor. Elev. 815′ A. T. B.

The coal has been mined for local fuel use at this point.

On Falling Rock creek, in the southwestern part of the district, the **No. 5 Block coal** appears to change into a **cannel bed,** and the Falling Rock Cannel Coal Company is mining coal from this bed and transporting the same by a short railroad to the Coal & Coke railroad at Falling Rock station:

Falling Rock Cannel Coal Company.—No. 74 on Map.

Located in Big Sandy district, on Falling Rock Creek, 4 miles southeast from Weir P. O.:

	Thickness Ft.	In.			
Slate	1	0			
Coal, Cannel	0	8	}	4′	10″
Shale, bituminous	0	5			
Coal, Cannel	1	8			
Slate	0	10			
Coal, bituminous	1	3			

Slate floor. Elev. 835′ A. T. B.

Crawford and Ashby Opening.—No. 75 on Map.

Located in Big Sandy district, on Wolf Pen Branch of Falling Rock Creek, near mouth of same:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, block	1	0			
Bone	0	4			
Coal, block	0	7	}	3′	7″
Fire clay and slate	1	1			
Coal, visible. Elev. 775′ A. T. B.	0	7			

The coal is mined for local use at this point.

MALDEN DISTRICT.

Malden district lies south of Elk and east of Loudon and Charleston. The **No. 5 Block coal** crops throughout the whole district, and appears in the highest hills in the southwestern portion of the same.

Blue Creek Coal & Land Company Opening.—No. 76 on Map.

Located in Malden district on Five-Mile Fork of Campbell creek, two miles northeast of Five-Mile station:

	Thickness Ft.	In.		
Sandstone, massive, roof	..	..		
Coal, hard	1	6	....	3' 7"
Slaty fire clay	0	3		
Coal, block	1	10		

Slate floor. Elev. 1035' A. T. B.

The coal is mined for local fuel.

Harry Litton Opening.—No. 77 on Map.

Located in Malden district on Mill Creek, 1.2 mile due south of Villa P. O.:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, good	1	9

Fire clay floor. Elev. 935' A. T. B.

The coal is mined for local fuel.

The No. 5 Block coal was once mined by H. E. Hudson, one mile south from Rutledge P. O., on Valley Grove Branch of Elk Two Mile creek. The opening had fallen shut, and the writer was unable to get an accurate section, but Mr. Hudson reports the coal 2 feet thick.

J. W. Belcher Opening.—No. 78 on Map.

Located in Malden district, on head of Cline branch of Campbell Creek, 2.5 miles southeast from Rutledge P. O.:

	Thickness Ft.	In.
Slate roof	1	10

	Thickness Ft.	In.			
Coal	0	6			
Slate	2	0	....	4'	6"
Coal	2	0			

Slate floor. Elev. 985' A. T. B.

The coal comes 110 feet above the base of the Kanawha Black Flint at this point, and is mined by Mr. Belcher for local fuel.

The Campbells Creek Coal Company has three mines at Putney, near the head of Campbells creek, in the **No. 5 Block** seam of coal.

Campbells Creek Coal & Coke Company Mine No. 1.
No. 79 on Map.

Located in Malden district at Putney:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, block	1	6			
Slate, black	..	4	....	4'	10"
Coal, hard, block. Elev. 1245' A. T. B...	3	0			

Campbells Creek Coal Company Mine No. 2.
No. 80 on Map.

Located in Malden district at Putney:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	1	7			
Slate (3" to 5")	0	4	....	4'	11"
Coal	3	0			

Sandstone. Elev. 1250' A. T. B.

Campbells Creek Coal Company Mine No. 3.
No. 81 on Map.

Located in Malden district at Putney.

Measurement taken by Ray V. Hennen and published in Vol II (A), page 539, West Virginia Geological Survey, 1906:

	Thickness Ft.	In.			
Slate	..	..			
Coal, gas .....1" / Slate .....1½ / Coal, gas 4	0	6½			
Slate, black, 4 ft. to	0	4			
Coal, "gas"	0	3			
Slate, black	0	0½			
Coal, "gas," hard	0	7			
Coal, gray splint, hard	0	10	....	6′	6″
"Niggerhead"	0	3			
Coal, splint, hard	1	7			
Coal, gray splint, hard	0	1			
Coal, semi-splint, hard	0	4			
Coal, "gas," hard	1	8			
Concealed, streak of coal and concealed				150′	0″
Kanawha Black Flint, (typical). 1240′ A. T. B.				6′	0″

Butts, S. 50° E.; faces, N. 40° E.

CABIN CREEK DISTRICT.

Cabin Creek district lies south of Elk and Malden. The **No. 5 Block coal** outcrops above the surface over the entire district, capping the highest hills in the southern part of the same.

J. Q. Dickinson Opening.—No. 82 on Map.

Located in Cabin Creek district on a branch of Laurel Fork of Bell Creek, 1.7 miles southeast of Spangler P. O., and 0.3 mile south of the Elk-Cabin Creek district line:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	0	2			
Coal, gas	0	8			
Coal, gray, splint	0	9	....	4′	3″
Coal, block	2	10			

Fire clay floor. Elev. 1240′ A. T. B.

The coal is mined for local use by the tenants living on Mr. Dickinson's lands.

Just below the mouth of Campbells Fork of Bell creek, there is another opening where coal was formerly mined for local use. The following section was measured there:

J. Q. Dickinson Opening.—No. 83 on Map.

Located in Cabin Creek district on Campbell Fork, one mile southeast from Pond Fork P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	0	10			
Bone	0	4	....	3′	3″
Coal, block	2	1			

Fire clay floor. Elev. 1285′ A. T. B.

G. W. Ramsey Opening.—No. 84 on Map.

Located in Cabin Creek district on the waters of Bell Creek, one mile southeast of Pond Gap P. O.:

	Thickness Ft.	In.			
Slate and sandstone	..	..			
Coal, cannel	2	0			
Sandstone and slate	10	0			
Coal	1	6			
Bone	0	2	....	4′	2″
Coal	2	6			

Slate floor. Elev. 1275′ A. T. B.

The coal is mined here for local fuel, and a 2 foot bed of cannel makes its appearance 10 feet above the main No. 5 Block.

The **No. 5 Block** coal is mined for local use by L. C. Hill, along the level valley from Bell creek to Blakeley, just south of the Elk-Cabin creek district line.

L. C. Hill Opening.—No. 85 on Map.

Located in Cabin Creek district, one-half mile northwest of Pond Gap P. O., and just south of the Elk-Cabin Creek district line:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, soft	0	6			
Slate	0	6			
Coal, hard, block	1	0	....	5′	6″
Slate	0	2			
Coal, block	3	4			

Slate floor. Elev. 1280′ L.
Butts Run, S. 50° E.; faces, N. 40° E.

In passing from Bell creek to Shadrack Fork of Hughes creek, the crop of No. 5 Block coal is visible at several points:

W. J. Keeney Opening.—No. 86 on Map.

Located in Cabin Creek district, on head of Shadrack Fork of Hughes Creek, 1.5 miles southwest of Pond Gap P. O.:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	0	10			
Impure coal	0	10			
Coal, "gas"	0	10	....	4'	6"
Slate	0	2			
Coal, block	1	10			

Slate floor. Elev. 1370' A. T. B.

The coal is mined for local use.

The No. 5 Block coal is mined by the Quincy Coal Company on Carroll Branch, at Quincy on the K. & M. Ry.:

Quincy Coal Company Mine.—No. 87 on Map.

Located in Cabin Creek district, 1.5 mile north of Quincy P. O.:

	Thickness Ft.	In.			
Sandstone, coarse grained	..	..			
Slate	2	1			
Coal, hard	1	4			
Bone	0	8	....	4'	10"
Coal, hard, block	2	10			

Fire clay floor. Elev. 1285' A. T. B.

The base of the coal is 140 feet above the base of the Kanawha Black Flint which crops just below the opening.

The Sunday Creek Company is mining the No. 5 Block coal on Kelly creek, near Marmet. The following is a secton of its mine, No. 109.

Sunday Creek Company Mine No. 109.—No. 88 on Map.

Located on Goose hollow of Kelly Creek, two miles northeast of Mammoth P. O.:

	Thickness Ft.	In.
Sandstone, massive	..	..
Slate, draw	1	1

	Thickness. Ft.	In.			
Coal, soft	1	2			
Slate, gray	0	4	....	5′	3″
Coal, block. Elev. 1275′ A. T. B.	3	9			

The same company formerly operated its mine No. 106, located on Hurricane Fork of Kelly creek, one mile east of Mammoth P. O., in the No. 5 Block coal, elevation 1315′ A. T. B. The mine is now abandoned.

Another opening made by the same company on Horse Mill Branch of Kelly creek shows the following section:

Sunday Creek Company Mine.—No. 89 on Map.

Located in Cabin Creek district, on Horse Mill branch of Kelly Creek, one mile due north of Cedar Grove P. O.:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal	0	6			
Slate	0	8½			
Coal, hard, bony	2	8	....	6′	3½″
Bone	0	3			
Coal, hard, block. Elev. 1290′ A. T. B.	2	2			

This bed is 180 feet over the Kanawha Black Flint, which crops out vertically below the opening.

On the left fork of Witchers creek, a prospect opening was made by the Sunday Creek Company, where the following section was measured:

Sunday Creek Company Mine.—No. 90 on Map.

Located on Left fork of Witchers Creek, 5 miles north of Shrewsbury P. O.

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	0	4			
Coal, block	2	4			
Bone	0	4			
Coal	0	6	....	5′	6″
Slate	0	2			
Coal, block	2	2			

Slate floor. Elev. 1315′ A. T. B.

The coal comes 170 feet above the Kanawha Black Flint.

Sunday Creek Co. Coal Opening.—No. 91 on Map.

Located in head of Carroll branch, one mile north of Shrewsbury P. O.:

	Thickness Ft.	In.			
Sandstone, coarse grained	..	..			
Slate	2	1			
Coal	1	4	}	5′	9″
Slate	..	8			
Coal, visible. Elev. 1285′ A. T. B.	3	9			

Sunday Creek Company Mine No. 2.—No. 92 on Map.

Located at Shrewsbury P. O. on K. & M. Ry.:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	2	10			
Coal	1	6	}	6′	0″
Slate, black	0	6			
Coal, block	4	0			

Slate floor. Elevation 1270′ A. T. B.

Dr. I. C. White gives the following section of the coal at this point in Volume II, page 300, West Virginia Geological Survey, 1903:

	Thickness Ft.	In.			
Sandstone	..	..			
Shale, blue	3	0			
Coal	1	6			
Black slate	0	6			
Coal, good	4	2			
Shale	2	6	}	17′	8″
Coal	0	6			
Shale	5	0			
Coal and slate	3	6			

Sandstone.

The Cedar Grove Colliery Company once operated a mine just west of Cedar Grove, where the following section was measured by Mr. S. D. Brady and published in Volume II, page 301:

Cedar Grove Colliery Company Mine.—No. 93 on Map.

Located in Cabin Creek district, one mile west of Cedar Grove.

	Thickness Ft.	In.		
Black slate			0′	3″
Coal, left up	0	3		
Coal	1	3		
Bone or "Niggerhead"	0	1		
Coal	0	6	.... 5′	8″
Bone or "Niggerhead"	..	1		
Coal	0	9		
Slate	0	2		
Coal	2	7		
Sandy shale			5′	6″
Coal, reported. Elev. 1300′ A. T. B.			3′	6″

The No. 5 Block coal has been prospected on Smithers creek by the Cannelton Coal Company, where the following section was measured:

Cannelton Coal Company Opening.—No. 94 on Map.

	Thickness Ft.	In.		
Shale and sandstone	..	..		
Coal, hard, block	5	2		
Sandstone, gray	2	5		
Coal, soft	1	2	.... 11′	4″
Bone	0	1		
Coal, block	2	6		

Fire clay floor. Elev. 1380′ A. T. B.

The top portion appears to be clean coal; but the section was not fully faced up, and may contain some impurities.

South of the Kanawha river, the **No. 5 Block coal** is mined along Morris creek on a commercial scale by the Eureka Coal Company, where the following section was measured:

Eureka Coal Company Mine.—No. 95 on Map.

Located on Morris Creek, one mile southwest from Donwood P. O.

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Slate	3	1		
Coal	1	0		
Slate	3	0	.... 9′	0″
Coal, hard, block	5	0		

Fire clay floor. Elev. 1600′ A. T. B.

The No. 5 Block coal is high on the hills, from 500 to 1000 feet above the floor of the valleys on Paint and Cabin creeks, and as there are several coals of workable thickness nearer the valleys, very little prospecting has been done for this bed in that portion of Cabin Creek district. Mr. C. A. Cabell, Gen. Manager of the Carbon Coal Company, had several strippings made on the head of Cabin creek, from top to bottom of the hills, exposing sections of the different coals. At one of these the following section of the **No. 5 Block** was measured by Krebs:

Republic Opening.—No. 96 on Map.

Located in Cabin Creek district at Republic.

	Thickness Ft.	In.			
Sandstone, shelly	..	..			
Slate	0	6			
Coal	0	4			
Slate	0	4			
Coal, soft	3	0	....	7′	9½″
Fire clay	0	1½			
Coal, hard block	4	0			
Slate floor. Elev. 2360′ A. T. B.					

A sample of this coal was analyzed in the laboratory of the Carbon Coal Company at Decota, with the following results:

Moisture	0.85%
Volatile Matter	37.77
Fixed Carbon	57.06
Ash	4.32
Total	100.00
Sulphur	.84
B. T. U.	14,868

The Anchor Coal Company of High Coal, W. Va., has recently made an opening in the **No. 5 Block** coal, just above its mine in the Dorothy bed where the following section was measured:

Anchor Coal Company Opening.—No. 97 on Map.

Located in Sherman district, Boone county, three-fourths mile south of the Kanawha-Boone county line.

	Thickness Ft.	In.
Sandstone, massive	..	..
Slate	2	0

	Thickness Ft.	In.			
Coal, hard	6	9			
Slate	0	1	....	8'	0"
Coal, soft	1	2			

Slate floor. Elev. 2125' A. T. B.

The No. 5 Block coal has been prospected on the hills of Fields creek, by the Winifrede Coal Company, where the following section was measured:

Winifrede Coal Company Opening.—No. 98 on Map.

Located in Cabin Creek district, two miles southeast of Winifrede P. O.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	2	0			
Coal, block	2	6			
Bone	0	2	....	4'	8"
Coal, block. Elev. 1345' A. T. B.	2	0			

The coal has been mined here for local use.

On the head of Slaughters creek, the following opening was measured:

Slaughters Creek Land Company Opening.—No. 99 on Map.

Located on head of Slaughters Creek, 4 miles southeast from Winifrede P. O.

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	2	0			
Slate	0	2	....	4'	2"
Coal	2	0			

Slate floor. Elev. 1360' A. T. B.

The sections given on the preceding pages illustrate the character and thickness of **No. 5 Block coal**, at different points in the magisterial districts of Kanawha county.

The thickness and depth of the **No. 5 Block** coal is also given in the summary of wells drilled in the northern part of Kanawha county for oil and gas, wherever the coal is noted in the record by the drillers, and could be identified. Of course very little importance can be attached to these records in re-

gard to the structure and thickness of the coal found, except that it shows the presence of some coal at the point where the wells were drilled.

It is quite difficult to approximate the available area and tonnage of the **No. 5 Block coal** in Kanawha, since, as already stated on preceding pages, the bed is deeply covered in the northern part of the county, and both its persistence and thickness are in question, while in the extreme southern part of the county the coal occurs high in the hills and has not been thoroughly prospected and proven. From the sections given of this bed the writer assumes the thickness in the different districts as given below. A careful calculation of its area left uneroded, as shown on the map accompanying this report, has been made with a planimeter by Teets, the results of which are given in the table by magisterial districts, figured on the basis of 25 cubic feet to the short ton, as with the Pittsburgh coal on page 416 with the following results:

Table Showing Approximate Available No. 5 Block Coal.

Districts	Sq. Miles	Acres	Thickness of Bed Ft.	Thickness of Bed In.	Cubic Feet of Coal	Short Tons of Coal
Big Sandy	48	30,720	3	3	4,349,030,400	173,961,216
Cabin Creek ..	50	32,000	5	0	6,969,600,000	278,784,000
Charleston	4	2,560	2	2	241,612,726	96,645,050
Elk	90	57,600	3	8	9,200,708,352	368,028,034
Loudon	60	38,400	3	6	5,854,464,000	234,178,560
Malden	12	7,680	3	8	1,226,761,114	49,070,445
Washington ...	40	25,600	2	4	2,601,612,288	104,064,492
Totals	304	194,560			30,443,788,880	1,304,731,797

The following table gives the comparative calorific value and fuel ratio of the coal in the No. 5 Block bed in Kanawha county:

Analyses of the No. 5 Block Coal in Kanawha County.

(Under the heading, "Condition of Sample", A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
24	J. H. Huling	Loudon	A. R.	1.44	39.62	51.60	0.006	7.34	1.07	.....	.....	.....	.....	.....	.....	.....
25	Jas. H. Ellison	Loudon	A. R.	1.49	39.45	49.57	0.006	9.49	1.31	.....	.....	.....	.....	.....	.....	.....
26	J. H. Huling	Loudon	A. R.	0.84	39.95	51.83	0.006	7.38	0.95	.....	.....	.....	.....	.....	.....	.....
31	Dr. G. A. MacQueen	Elk	A. D.	1.32	37.55	54.36	0.021	6.77	1.78	75.69	5.05	9.29	1.42	13757	13493	4.71
31	Dr. G. A. MacQueen	Elk	A. R.	2.26	37.20	53.84	0.020	6.70	1.76	74.98	5.10	10.05	1.41	13626	13365	4.48
33	Coopers Creek Coal Co.	Elk	A. R.	1.65	36.27	48.96	0.009	13.12	2.21	.....	.....	.....	.....	.....	.....	.....
36	Cespe-Kanawha Coal Co.	Elk	A. R.	0.72	36.58	52.25	0.006	10.45	2.69	.....	.....	.....	.....	.....	.....	.....
39	Villa Coal Mining Co.	Elk	A. R.	0.57	45.39	43.73	0.009	10.31	1.58	.....	.....	.....	.....	.....	.....	.....
42	Cedar Run Colliery Co.	Elk	A. D.	1.90	33.75	52.76	0.005	11.59	1.24	70.91	4.57	10.74	0.95	12920	12373	3.18
46	Standard Kanawha C. Min. Co.	Elk	A. R.	1.00	36.80	52.58	0.006	9.62	2.64	71.77	4.97	9.65	1.35	13160	12880	3.72
48	Williamg Coal Co.	Elk	A. R.	0.95	35.77	55.49	0.007	7.79	0.67	74.03	3.89	11.43	1.19	13490	12940	3.85
59	Jefferson Johnson	Elk	A. R.	0.90	37.60	57.50	0.004	4.00	0.69	.....	.....	.....	.....	.....	.....	.....
60	Blue Creek C. & L. Co.	Elk	A. D.	1.60	34.20	58.90	0.008	5.30	0.56	76.33	4.91	11.69	1.21	13629	13263	4.49
60	Blue Creek C. & L. Co.	Elk	A. R.	1.89	34.10	58.73	0.008	5.28	0.56	76.11	4.94	11.90	1.21	13588	13224	4.43
*60	Blue Creek C. & L. Co.	Elk	A. R.	1.26	38.20	55.54	0.006	5.00	0.64	77.31	5.25	10.55	1.25	14170	13710	4.97
60A	Blue Creek C. & L. Co.	Elk	A. R.	1.13	38.66	54.83	0.004	5.38	0.63	.....	.....	.....	.....	.....	.....	.....
61	Blue Creek C. & L. Co.	Elk	A. D.	1.65	31.65	56.02	0.015	10.68	0.76	74.13	4.02	9.12	1.29	13063	12598	3.74
61	Blue Creek C. & L. Co.	Elk	A. R.	1.99	31.54	55.83	0.015	10.64	0.76	73.87	4.06	9.38	1.29	13017	12568	3.69
*61	Blue Creek C. & L. Co.	Elk	A. R.	1.08	37.41	54.14	0.006	7.37	0.66	75.14	5.15	10.37	1.31	13790	13350	4.24
63	L. V. Koontz & Bros.	Big Sandy	A. D.	0.80	38.80	50.42	0.012	9.98	3.26	72.12	4.60	9.08	0.96	13080	12764	3.78
67	Claybrook Coal Co.	Big Sandy	A. R.	1.36	39.55	53.46	0.002	5.63	1.04	76.96	5.16	10.05	1.16	13860	13660	4.91
68	John Tawny	Big Sandy	A. R.	1.65	42.28	51.33	0.006	4.74	1.45	.....	.....	.....	.....	.....	.....	.....
69	Queen Shoals Coal Co.	Big Sandy	A. R.	1.09	38.14	54.88	0.005	5.89	0.93	.....	.....	.....	.....	.....	.....	.....
70	Queen Shoals Coal Co.	Elk	A. R.	1.31	40.94	52.51	0.003	5.24	1.14	76.70	5.30	10.16	1.46	14020	13700	4.98
71	Morris Fork Coal Co.	Big Sandy	A. D.	1.25	35.20	56.86	0.006	6.69	1.34	75.33	5.07	10.44	1.13	13605	13343	4.40
72	King Land Co.	Big Sandy	A. R.	4.52	31.01	54.70	0.497	9.77	0.64	.....	.....	.....	.....	.....	.....	.....
95	Eureka Coal Co.	Cabin Creek	A. R.	1.18	37.02	55.21	0.005	6.59	0.60	76.72	5.07	9.56	1.37	14140	13590	4.75

*Sample collected by Mr. Teets.

Page References to Detailed Description and Section of Coal Openings and Mines Listed in Preceding Table. No. 5 Block Coal.

Map No.	Laboratory No.	NAME OF OWNER	Page of this Report
24	329	J. H. Huling	422
25	332	James H. Ellison	423
26	330	James H. Huling	423
31	17	Dr. G. A. MacQueen	425
33	336	Coopers Creek Coal Co	426
36	Vol. II(A) P. 547	The Cespe-Kanawha Coal Co	427
39	333	Villa Coal Mining Co	428
42	Bul. II P. 297, No. 12	Cedar Run Colliery Co	430
46	347	Standard Kanawha Coal Mining Co	431
48	348	Williams Coal Co	432
59	358	Jefferson Johnson	435
60	344	Blue Creek Coal & Land Co. (Blakeley)	436
61	345	Blue Creek Coal & Land Co. (Wills Hollow)	436
63	Bul. II. P. 297	L. V. Koontz & Bros	437
68	360	John Tawney	439
69	378	Queen Shoals Coal Co	439
71	Bul. II. 297, No. 10	Morris Fork Coal Co	440
95	349	Eureka Coal Co	449
67	377	Claybrook Coal Mining Co	438
72	353	King Land Co	440
77	335	Harry Litton	442

COALS OF THE KANAWHA SERIES.

The Stockton-Lewiston Coal.

The first coal bed of economic importance in descending order, in the Kanawha series, is the Stockton-Lewiston coal. A full description of its structure, character and distribution in Kanawha county, has been given in preceding pages of this report.

The coal openings and mines will now be taken up in detail by magisterial districts:

CHARLESTON DISTRICT.

The Stockton-Lewiston coal crops at the northeast end of Morris Street, Charleston, and has been mined locally on Ruffner Branch and on Wilson Branch:

G. J. Floyd Opening.—No. 100 on Map.

Located in Charleston district, on Wilson Branch:

	Thickness Ft.	In.			
Kanawha Black Flint	4	0			
Sandy shale	4	0			
Slate	1	0			
Coal, impure	2	0	....	4′	0″
Coal, block; Elev. 750′ A. T. B.	2	0			

The above section illustrates the character and thickness of the Stockton-Lewiston bed in Charleston district.

WASHINGTON DISTRICT.

The **Stockton-Lewiston coal** rises above the grade of the Coal River Branch of the Chesapeake & Ohio Railroad, just east of Sproul. There the following section was measured:

Sproul Opening.—No. 101 Map.

Located in Washington district, on Big Coal river, near Sproul station:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Sandy shale	5	0			
Coal, slaty	0	11			
Fire clay	0	7			
Coal, slaty	0	4	....	7′	0″
Coal, block, good	1	2			
Fire clay, impure	1	6			
Coal, visible; Elev. 610′ A. T. B.	2	6			

The coal rises rapidly to the southeast, and at Brounland is well above the valley where the following section was measured:

Courtney and Broun Opening.—No. 102 on Map.

Located in Washington district, near Brounland:

	Thickness Ft.	In.			
Sandy slate	..	..			
Coal, impure	0	9			
Fire clay	0	8			
Coal, slaty	0	8			
Coal, cannel, impure	1	7			
Bituminous shale	1	6			
Fire clay	1	0	....	12′	4
Coal, hard, block	1	6			
Fire clay	1	6			
Coal, splint	1	2			
Bone	0	4			
Coal, splint, visible; Elev. 670′ A. T. B...	1	8			

The lower portion of this coal was once mined for local fuel use at Brounland, and reported to be 3 feet thick.

The coal is mined by John Myers, on Brier creek, for local fuel, where the following section was measured:

John Myers Opening.—No. 103 on Map.

Located in Washington district, on Brier creek, 1 mile east of Brounland P. O.:

	Thickness Ft.	In.			
Sandstone, massive.					
Slaty shale with streaks of coal	1	2			
Coal, hard, block	1	2			
Slate	0	1	....	4′	9″
Coal, splint	1	6			
Bone	0	2			
Coal, soft	0	8			

Fire clay; Elev. 785′ A. T. B.

The coal continues rising rapidly southeastward from this point until on the head of Brier creek, it crops high on the hills at 1300′ A. T. B.

LOUDON DISTRICT.

The **Stockton-Lewiston coal** rises out of Davis creek, just below the mouth of Stitt Branch, where the following section is exposed in the railroad grade, on land of D. G. Courtney.

STANFORD LIBRARY

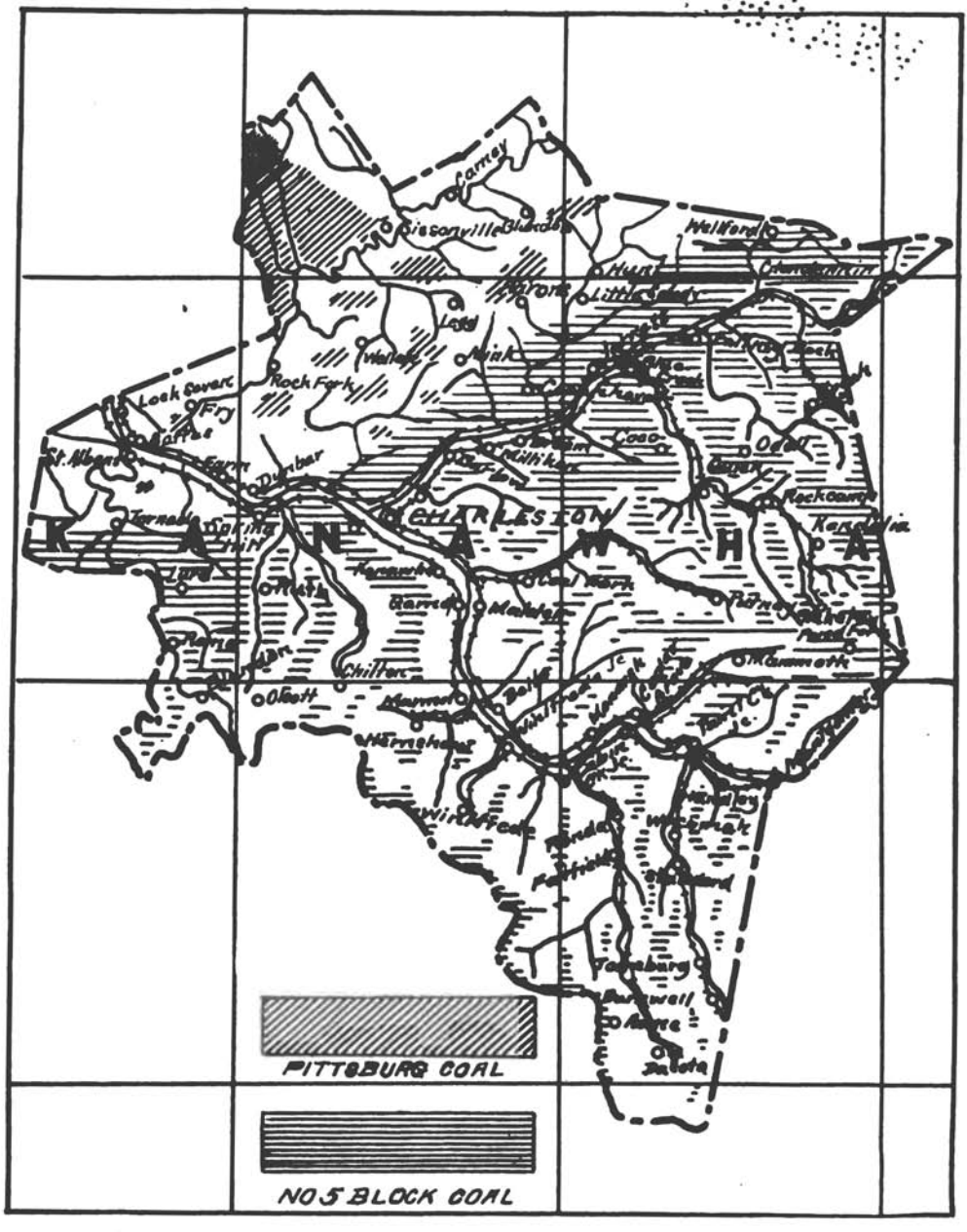
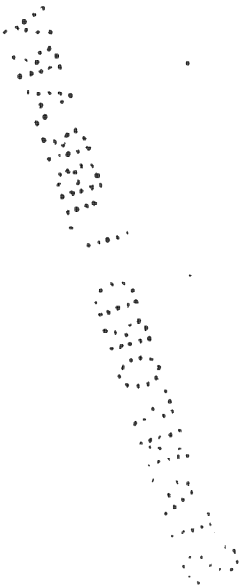


Fig. 13—Showing Approximate Area of Available No. 5 Block Coal and Pittsburgh Coal in Kanawha County.



D. G. Courtney Opening.—No. 104 on Map.

Located in Loudon district, on Davis creek, just north of mouth of Stitt Branch:

	Thickness Ft.	In.			
Sandstone.					
Coal blossom	2	2			
Fire clay	0	10			
Coal, impure	0	8	....	4'	7"
Fire clay	0	6			
Coal, impure, visible; Elev. 635' A. T. B.	0	5			

The Stockton-Lewiston coal rises rapidly to the southeast until near the head of Davis creek the coal crops in the divide between Davis creek and Lens creek at an elevation of 1310 feet A. T. B.

This coal was once opened on the hill south of Marmet, where the following section was measured:

Gould and Parker Opening.—No. 105 on Map.

Located in Loudon district, ½ mile west of Marmet.

	Thickness Ft.	In.			
Kanawha Black Flint.					
Sandy shale and concealed	25	0			
Slate	3	0			
Coal	0	6			
Sandy shale	5	0			
Coal, cannel	1	0	....	9'	6"
Slate	1	6			
Coal, cannel; Elev. 1215' A. T. B.	1	6			

The Stockton-Lewiston coal rises above the Chesapeake and Ohio Railroad grade, just east of the Charleston depot, and has been mined on Lick Branch for local fuel. The opening exhibits the following section:

Johnson Cook Opening.—No. 105A on Map.

Located in Loudon district, on Lick Branch, 1.5 miles from its mouth.

	Thickness Ft.	In.
Kanawha Black Flint	3	0
Sandy shale	4	0

	Thickness Ft.	In.			
Slate	0	2			
Coal, soft	0	6			
Coal, impure	0	10	....	3′	10″
Coal, block	1	3			
Bone	0	1			
Coal, block	1	0			

Fire clay floor; Elev. 795′ A. T. B.

MALDEN DISTRICT.

The Stockton coal has been opened in several places in Malden district on Campbell creek and its tributaries.

Virginia Coal Company.—No. 106 on Map.

Located in Malden district, in Allum Branch of Campbell creek, ½ mile northeast from Coal Fork P. O.:

	Thickness Ft.	In.			
Sandstone, massive	10	0			
Slate	1	10			
Coal, splint	2	7	....	6′	2″
Fire clay	0	2			
Coal	1	7			

Fire clay floor; Elev. 1000′ A. T. B.

The Kanawha Black Flint is 25 feet above the coal, at this point.

The Stockton-Lewiston coal crops on Clover hollow of Campbell creek about one mile from its mouth, at an elevation of 870 feet A. T. B., and is about 4 feet thick, 25 feet under the Kanawha Black Flint.

W. D. Lewis Opening.—No. 107 on Map.

Located in Malden district, on Cline Branch, 1.5 miles northeast from Coal Fork P. O.:

	Thickness Ft.	In.			
Slate roof.					
Coal, hard, block	0	10			
Slate	0	10			
Coal, hard, block	1	0			
Slate	0	3	....	4′	9″
Coal, block	0	6			
Slate	0	4			
Coal, hard	1	0			

Fire clay floor; Elev. 850′ A. T. B.

The coal has been mined for local fuel.

Blue Creek Coal & Land Company Opening.—No. 108 on Map.

Located in Malden district, on Eight mile fork of Campbell creek, 2 miles northeast of Eight station:

	Thickness Ft.	In.			
Kanawha Black Flint.					
Sandy shale and concealed	30	0			
Slate	0	6			
Coal, block	1	6			
Slate with streaks of coal	2	6	....	5′	0″
Coal, block, visible; Elev. 980′ A. T. B.	1	0			

Perryville Coal Company Mine.—No. 108(A) on Map.

Located in Malden district, on Campbell creek, 1.3 miles southeast of Five Mile station:

		Thickness Ft.	In.			
1.	Sandstone.					
2.	Slate	0	1			
3.	Coal, splint	1	2			
4.	Slate	0	5			
5.	Coal, block	1	7			
6.	Niggerhead	0	4			
7.	Coal	0	5	....	9′	1″
8.	Slate, black	0	10			
9.	Coal, block	2	1			
10.	Niggerhead	0	6			
11.	Coal, block	1	9			

12. Slate floor; Elev. 960′ A. T. B.

Butts, N 15° W; Faces, N 75° E. Sample taken from Nos. 3, 5, 7, 9 and 11.

The mine began shipping coal August, 1913.

D. G. Courtney Opening.—No. 109 on Map.

Located in Malden district, on southside of Point Lick Branch of Campbell creek; Section measured by John C. Child, Charleston, West Virginia:

	Thickness Ft.	In.			
Slate roof.					
Coal	0	10			
Slate	0	3			
Coal	1	4			
Slate	0	3			
Coal	3	6	....	9′	9″
Slate	0	8			
Coal	1	0			
Bone	0	3			
Coal; Elev. 1050′ A. T. B.	1	8			

A. H. Boyd Opening.—No. 109A on Map.

Located in Malden district, on Nine Mile fork, 3 miles southwest from Putney:

Kanawha Flint.	Thickness Ft.	In.			
Sandy shale and concealed	35	0			
Coal	3	6			
Slate	0	6	...	5′	6″
Coal, impure	0	6			
Coal, hard, block; Elev. 1085′ A. T. B.	1	0			

The top layer, 3 ft. 6 in. thick, appears to be clean, and of good quality.

Another section was measured on Right Fork of Nine Mile creek, the section showing as follows:

A. H. Boyd Opening.—No. 110 on Map.

Located in Malden district, on Right Branch of Nine Mile Branch, 4 miles west from Putney:

Sandstone roof.	Thickness Ft.	In.			
Coal, semi-splint	0	6			
Coal, hard, block	1	2			
Slate, bituminous	0	6			
Coal	0	8	....	10′	6″
Slate, bituminous	1	6			
Coal, hard, block	1	0			
Sandy shale and slate	4	6			
Coal, cannel, visible; Elev. 1105′ A. T. B.	0	8			

Another opening measured on Ten Mile Fork of Campbell creek shows as follows:

A. H. Boyd Opening.—No. 111 on Map.

Located on Ten Mile Fork of Campbell creek, 1.6 miles southwest from Putney:

Kanawha Flint.	Thickness Ft.	In.			
Sandstone and concealed	34	0			
Slate	1	0			
Coal	0	2			
Slate	0	2			
Coal, hard	0	4			
Slate	0	4	....	5′	2″
Coal, hard, block	2	10			
Slate	0	10			
Coal, visible; Elev. 1070′ A. T. B.	0	6			

The opening had fallen in and the writer was unable to get a measurement of the lower part of the coal.

The following section was measured at mouth of Carver Branch of Campbell creek by Ray V. Hennen and published in Vol. II(A), page 539, West Virginia Geological Survey, 1908:

Campbell Creek Opening.—No. 112 on Map.

Located in Malden district, 1 mile west of Putney:

	Thickness Ft.	In.			
Kanawha Black Flint.					
Shale, sandy	25	0			
Coal, gas	0	5			
Bone	0	2			
Coal, splint	2	0			
Slate	0	2	....	5′	7″
Coal, slaty	1	0			
Slate	0	3			
Coal, slaty	0	4			
Coal, splint; Elev. 1070′ A. T. B.	1	3			

The above opening is a prospect made by the Campbells Creek Coal Company.

ELK DISTRICT.

The Stockton-Lewiston coal comes to the surface in Elk district along Blue creek, near the mouth of Billy Branch, and crops in the hills as far south as Blakeley:

Catharine Morris Opening.—No. 113 on Map.

Located in Elk district, on Spangler Fork of Middle Fork of Blue creek, near Spangler P. O.:

	Thickness Ft.	In.			
Kanawha Black Flint.					
Sandy shale	20	0			
Coal	0	2			
Slate and shale	0	10			
Slate, gray	4	0			
Coal, splint	2	2	....	9′	0″
Slate, gray	0	1			
Coal	0	3			
Slate	0	4			
Coal, block	1	2			

Fire clay floor; Elev. 1084′ L.

The coal is mined for local use.

George Dillard Opening.—No. 114 on Map.

Located in Elk district, on Spruce Fork of Middle Fork of Blue creek, 1.6 miles northwest from Blakeley P. O.:

	Thickness Ft.	In.		
Kanawha Black Flint.				
Sandy shale and concealed	25	0		
Slate	0	3		
Coal	0	4		
Slate	0	1		
Coal, block	1	6		
Slate	0	2	....	2′ 9″
Coal	0	2		
Coal, impure	0	6		
Coal, block, visible; Elev. 1070′ A. T. B.	1	0		

The coal is mined for local fuel.

The Stockton-Lewiston coal has been opened at Blakeley, by the Blue Creek Coal & Land Company, and was mined on a commercial scale for a while, but is now abandoned.

The following section of the coal was furnished by Mr. G. S. Plumbley, Chief Engineer of the Company, No. 113A on Map.

		Thickness Ft.	In.		
1.	Slate.				
2.	Coal, doubtful, gas	1	2		
3.	Shale, bituminous	0	4		
4.	Coal, splint	1	2	....	5′ 10″
5.	Coal, doubtful, gas	1	8		
6.	Coal, good, gas	1	6		

The different layers were analyzed separately by the Company with the following results:

Section No.	Water	Vol. Mat.	Fix. Car.	Ash	Sulphur	B. T. U.
2	1.390	38.30	53.54	6.77	1.023	13,964
3	1.50	25.57	28.96	43.97	.917	7,933
4	1.01	34.27	50.35	14.37	.576	12,864
5	2.44	29.32	46.27	21.97	.706	11,493
6	2.46	35.44	58.71	3.39	.777	14.865

The five samples have a proportionate relation as to the thickness to the whole seam as follows:

No. 2	20.6%
No. 3	5.9%
No. 4	20.6%
No. 5	29.4%
No. 6	23.5%
Total	100.00

Using these proportionate percentages, in the foregoing analyses, the following average analysis of the whole seam is found:

Water	1.878%	
Volatile Matter	33.412%	
Fixed Carbon	50.520%	
Ash	14.19 %	
Sulphur	0.774	B. T. U. 12,866

CABIN CREEK DISTRICT.

The Stockton-Lewiston coal crops in the hills throughout Cabin Creek district, and is mined on a commercial scale along Kanawha river and on Cabin creek.

Kelly Creek Colliery Opening.—No. 115 on Map.

Located in Cabin Creek district, on Five-Mile Fork of Kelly Creek, 1.2 miles southeast of Mammoth P. O.:

	Thickness Ft.	In.		
Sandstone	..	..		
Slate, gray	0	9		
Coal, hard	1	0		
Bone	0	2		
Coal, block	1	8		
Bone	0	1		
Coal	1	3	....	6′ 0″
Slate, block	0	1		
Coal	0	2		
Black slate and coal mixed	1	1		
Coal, good, vis. Elev. 1155′ A. T. B.	0	6		

The base of this opening is 40 feet under the Kanawha Black Flint, and 40 feet over the **Coalburg coal.**

John Morlin Opening.—No. 116 on Map.

Located in Cabin Creek district, at the head of Shadrick Fork of Hughes Creek, 4 miles east of Mammoth P. O.:

	Thickness Ft.	In.			
Shale roof	..	..			
Coal	1	2			
Slate, gray	0	5			
Coal, block	1	9			
Bone	0	4	....	7′	8″
Coal, block	2	5			
Slate, gray	0	5			
Coal	1	2			

Slate floor. Elev. 1175′ A. T. B.

The coal is mined at this point for local fuel.

Sunday Creek Opening.—No. 117 on Map.

Located in Cabin Creek district, on Kelly Creek, one mile due east of Mammoth P. O.:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate, dark	0	8			
Coal	1	1			
Bone	0	2			
Coal, splint, block	2	8			
Slate, gray	0	4			
Coal	0	9	....	7′	4″
Slate	0	2			
Coal	0	8			
Slate, gray	0	3			
Coal, hard block, vis. Elev. 1095′ A. T. B.	1	3			

The base of the coal comes 37 feet under the base of the Kanawha Black Flint ledge.

The Stockton-Lewiston coal was once mined at Cannelton, where the coal first received its name. A section of the coal at that locality is given on a preceding page of this report.

This coal has been mined and shipped for many years on the south side of the Kanawha river, just west of Crown Hill P. O., where the coal has been called the "Belmont" seam:

This mine was formerly operated by the Pawnee Coal Company, now the National Bituminous Coal & Coke Company:

The following section was measured at the "Black Cat" mine, near Crown Hill:

National Bituminous C. & C. Company.—No. 118 on Map.

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, bone	0	1			
Coal, splint	0	2	....	3′	11″
Slate	0	3			
Coal, block	3	5			

Slate floor. Elev. 1270′ A. T. B.
Butts, S. 70° E.; faces, S. 20° W.; greatest rise southeast.

The Stockton-Lewiston coal was once mined by the Dry Branch Coal Company at Dry Branch. The opening was fallen shut and the writer was unable to get a detailed section, but the following section was measured by Mr. Grout and published in Vol. II(A) of the West Virginia Geological Survey Reports, page 470:

Dry Branch Coal Company Mine.—No. 119 on Map.

Located in Cabin Creek district at Dry Branch.

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Slate	2	0			
3.	Coal, soft	0	8			
4.	"Niggerhead	0	2	....	3′	10″
5.	Coal, soft, (some 1″ splint layers)..	3	0			

6. Slate floor. Elev. 1211′ A. T. B.
Butts, east; faces, north. Samples taken from Nos. 3 and 5.

The bed occurs 29 feet under the Kanawha Black Flint, and 61 feet above the Coalburg seam which is mined at this locality.

The Cardiff Coal Company, now the Wyatt Coal Company of Charleston, W. Va., once mined the **Stockton-Lewiston coal** on Paint Branch of Cabin creek, where the following section was measured:

Wyatt Coal Company.—No. 120 on Map.

Located in Cabin Creek district on Paint branch of Cabin Creek:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	1	4			
Coal, soft	2	11	}		
Bone, "Niggerhead"	0	2	}	3'	10"
Coal, soft	0	9	}		

Slate floor. Elev. 1140' A. T. B.

Butts, north; faces, east. Sample of the coal taken by Mr. Grout.

Wyatt Coal Company.—No. 121 on Map.

Located in Cabin Creek district, at Sand City station on Cabin Creek:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	0	2	}		
Bone, 1½ to 2"	..	..	}		
Coal	2	9	}	4'	9"
Bone	0	1	}		
Coal	1	9	}		

Slate floor. Elev. 1160' A. T. B.

Butts, north; faces, east.

Cabin Creek Consolidated C. & C. Co. (Ohley Mine). No. 122 on Map.

Located in Cabin Creek district at Ohley, on Cabin Creek:

	Thickness Ft.	In.			
Sandstone	..	..			
Coal	2	6	}		
Slate	0	2	}	5'	2"
Coal	2	6	}		

Slate floor. Elev. 1300' A. T. B.

Butts, north; faces, east.

The National Bituminous Coal & Coke Company (formerly Holly and Stephenson Coal & Coke Company) are mining the **Stockton-Lewiston coal** on Cane Fork, at Eskdale P. O., and the following section was measured there.

National Bituminous Coal & Coke Co.—No. 123 on Map.

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, 10"—24"	1	5			
Slate, 12"—24"	1	6			
Coal, hard	2	6	....	8′	6″
Slate	0	1			
Coal	3	0			

Slate floor. Elev. 1480′ A. T. B.
Butts, N. 10° W.; faces, N. 80° E.

The Southern Collieries Co.—No. 124 on Map.

Located in Cabin Creek district, on Cane Fork at Beth P. O.:

	Thickness Ft.	In.			
Coal, hard	0	10			
Slate	0	1			
Coal	1	0			
Slate	..	½	....	7′	8½″
Coal	2	10			
Slate	..	1			
Coal	2	10			

Slate floor. Elev. 1660′ A. T. B.
Butts, S. 10° E.; faces, N. 80° E.

This company was formerly known as the Lamont Company.

The Stockton-Lewiston coal is mined for local use in several localities on the head of Coal Fork of Cabin creek, one of which exhibits the following structure:

Allen Foster Opening.—No. 125 on Map.

Located in Cabin Creek district on head of Coal Fork:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, splint	1	0			
Slate	0	2	....	5′	1″
Coal, splint	3	11			

Slate floor. Elev. 1435′ A. T. B.

Just over the divide between Coal Fork of Cabin creek and Joes creek another opening in the **Stockton-Lewiston** seam has been made by Allen Foster, as follows:

Allen Foster Opening.—No. 126 on Map.

Located in Sherman district, Boone county, one-fourth mile south of the Kanawha-Boone county line:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, splint	1	0			
Slate, 1"-2"	..	1½	....	7'	0½"
Coal, splint	5	11			

Slate floor. Elev. 1425' A. T. B.

Tom Foster Opening.—No. 127 on Map.

Located in Sherman district, Boone county, and one-half mile south of opening No. 126:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, splint	0	10			
Slate	0	2	....	6'	11"
Coal	5	11			

Slate floor. Elev. 1420' A. T. B.

Frank Scott Opening.—No. 128 on Map.

Located in Cabin Creek district, on head of Coal Fork of Cabin Creek:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, splint	2	2			
Slate	0	1			
Coal	0	9			
Slate	0	2	....	4'	6"
Coal	0	6			
Slate	0	1			
Coal	0	9			

Slate floor. Elev. 1465' A. T. B.

Just over the divide between Coal Fork and White Oak creek of Coal river, the coal has been mined by Silas Massy, where the following section was measured:

Silas Massy Opening.—No. 129 on Map.

Located in Sherman district, Boone county, on head of White Oak Creek:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	0	4			
Coal, good, splint	0	7			
Slate, gray	0	1			
Coal, block, glossy	1	8			
Slate, gray	0	2			
Coal, gray, splint	1	0	....	5′	3″
Bone	0	3			
Coal, gray, splint	0	10			
Slate, gray	0	1			

Coal, block. Elev. 1520′ A. T. B.

Another opening made in this bed by the Webb Coal Company on Packs Branch of Coal river, shows the following:

Webb Coal Company Opening.—No. 130 on Map.

Located in Sherman district, Boone county on Packs Branch of Coal River, and 5.7 miles due west of Kayford:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	0	2			
Coal, good, splint	1	7			
Slate	0	3			
Coal, splint	2	1	....	5′	4″
Slate, gray	0	4			
Coal, visible. Elev. 1535′ A. T. B.....	1	1			

Slaughters Creek Coal Co. Opening.—No. 131 on Map.

Located on Slaughter Creek at the mouth of Dotson Fork:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate, gray	1	7			
Coal, block	2	1			
Sandstone, bluish gray	0	2	....	3′	4″
Coal, block	1	1			

Fire clay floor. Elev. 1100′ A. T. B.

The coal is mined for local use.

Slaughters Creek Coal Co. Opening.—No. 132 on Map.

Located in Cabin Creek district on head of Maple Fork of Slaughter Creek:

	Thickness Ft.	In.			
Shale and sandstone	..	..			
Slate	1	1			
Coal	0	8			
Slate, gray	0	½			
Coal	0	4	....	2′	7½″
Bone	0	3			
Coal, block	1	4			

Slate floor. Elev. 1215′ A. T. B.

The coal is mined for local use.

The Lewis Coal & Coke Company is mining the **Stockton-Lewiston coal** at Cabin Creek Junction, where the following section was measured:

Lewis Coal & Coke Co.—No. 133 on Map.

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	1	1			
Bone	0	1½	....	3′	11½″
Coal, block	2	9			

Fire clay floor. Elev. 1130′ A. T. B.
Butts, N. 10° W.; faces, N. 80° E.

The coal is used for steam, general fuel, and domestic purposes, being shipped both east and west. The Chesapeake and Ohio Railroad is also furnished with coal from this mine for locomotive fuel.

Lackawanna Coal & Lumber Co. (Greenbrier Mine No. 3). No. 133A on Map.

Located in Cabin Creek district, on Cane Branch of Paint Creek, one-half mile south of Tomsburg. Measurement taken by Ray V. Hennen and published in Vol. II (A), page 472, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Draw slate	0	5			
3.	Coal, splinty and soft	2	0			
4.	Slate, dark, hard	0	3	....	6′	1″
5.	Coal, splint, hard	3	10			
6.	Sandstone	..	..			

Elevation (aneroid), 1870 feet above tide. Coal shipped east and west for steam and domestic purposes. Samples from Nos. 3 and 5, and a separate sample from No. 3 for analysis.

The coal is 700 feet above the level of the **Eagle coal** mined in the hills below.

Lackawanna Coal & Lumber Co. (Banner Mine). No. 133C on Map.

Located in Cabin Creek district on Paint Creek on north side of Left Hand Branch, one mile above Wacomah station. Measurement taken by Ray V. Hennen and published in Vol. II(A), page 472, West Virginia Geological Survey, 1908:

		Thickness	
		Ft.	In.
1.	Kanawha black flint, "hard as a steel rail"	2	0
2.	Fire clay, shale and slate	8	0
3.	Coal, soft, gas 0′ 6″		
4.	Fire clay 6′ 0″		
5.	"Niggerhead' 0′ 6″		
6.	Coal, hard splint, fine 3′ 1″	13	3
7.	Slate, black 0′ 4″		
8.	Coal, hard splint 0′ 4″		
9.	Concealed and massive sandstone	100	0
10.	Coal, Coalburg	9	1

Elevation (aneroid), 1290 feet above tide. Butts, N. 30 degrees E.; faces S. 60 degrees E.; greatest rise, S. 60 degrees E. Coal shipped east and west for steam and domestic purposes. Samples from Nos. 6 and 8 for analysis.

The succession from the Black Flint down to No 4 was not observed by Hennen, but is as given by the mine foreman, Mr. D. L. Waters, who sunk the ventilating shaft through the **flint** to the coal.

The available area and tonnage of the **Stockton-Lewiston coal** can only be approximately calculated, since, as already stated on preceding pages of this volume, although the bed is a very persistent one, yet it contains considerable impurities, in different parts of the county, while in other parts of the county, as on Cabin creek, the bed is reasonably pure, and makes an excellent steam, domestic, and general fuel coal.

A careful calculation of its area left uneroded, as shown on a map accompanying this report, has been made with a planimeter by Teets, the results of which are given in the following table by magisterial districts. Figured on the basis of 25 cubic feet to the short ton as with the Pittsburgh coal on a previous page:

Table Showing Approximate Tonnage of Available Stockton-Lewiston Coal.

Districts	Sq. Miles	Acres	Thickness of bed Ft.	In.	Cubic Feet of Coal	Short Tons of Coal
Big Sandy.....	55	35,200	3	9	5,749,920,000	229,996,800
Cabin Creek ...	60	38,400	5	0	8,363,520,000	334,540,800
Charleston	5	3,200	3	6	487,872,000	19,514,880
Elk	100	64,000	3	9	10,454,400,000	418,176,000
Loudon	65	41,600	3	0	5,436,288,000	217,451,420
Malden	15	9,600	4	0	1,672,704,000	66,908,160
Washington ...	40	25,600	3	6	3,902,976,000	156,119,040
Totals	340	217,600			36,067,680,000	1,442,707,100

The following table gives the comparative calorific value and fuel ratio of the coal in the Stockton-Lewiston bed in Kanawha county:

Analyses of Stockton-Lewiston Coal in Kanawha County.

(Under the heading "Condition of Sample", "A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample	Proximate.				Common to both.		Ultimate.				Ca'orimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
106	Virginia Coal Co.	Malden	A. R.	1.85	32.48	50.41	0.008	15.26	0.85	65.96	4.37	12.20	1.36	12070	12050	2.40
108A	Perryville Coal Min. Co.	Malden	A. R.	1.85	36.30	55.69	0.002	6.16	1.06	74.43	5.05	12.14	1.16	13100	13060	3.60
113	Catharine Morris	Elk	A. R.	1.30	36.42	58.20	0.009	4.08	1.10	.....	.....	.....	.....	.....	.....	.....
113A	Blue Creek C. & L. Co.	Elk	A. D.	1.90	33.68	61.98	0.009	2.44	0.80	81.43	5.13	9.02	1.18	14372	14357	7.12
*113A	Blue Creek C. & L. Co.	Elk		2.05	33.63	61.88	0.009	2.44	0.80	81.31	5.15	9.12	1.18	14351	14346	7.03
118	National Bituminous C. & C. Co.	Cabin Creek	A. D.	1.33	32.94	60.94	0.002	4.79	0.76	80.73	4.94	7.76	1.28	14126	14230	6.43
119	Dry Branch Coal Co.	Cabin Creek	A. D.	1.43	36.41	58.75	0.001	3.41	0.63	79.61	6.04	9.30	1.23	14481	14621	6.26
120	Wyatt Coal Company	Cabin Creek	A. D.	2.05	31.85	59.19	0.004	6.91	0.74	71.72	6.11	13.63	1.17	13322	13185	3.49
121	Wyatt Coal Company	Cabin Creek	A. D.	1.37	34.38	58.14	0.001	6.11	0.74	76.64	5.95	9.67	1.18	13906	14123	4.86
122	Cabin Cr. Cons. Coal Co. (Davis Mine)	Cabin Creek	A. R.	0.96	39.07	53.39	0.004	6.58	1.40	76.71	4.93	9.29	1.09	14060	13550	4.83
123	National Bituminous C. & C. Co.	Cabin Creek	A. R.	0.93	36.60	54.75	0.004	7.72	1.69	74.57	5.07	9.72	1.23	13860	13310	4.22
124	Southern Collieries Co.	Cabin Creek	A. D	1.35	31.45	58.06	0.002	9.14	1.46	73.36	5.67	9.80	1.13	13507	13489	3.87
125	Allen Foster	Cabin Creek	A. R.	1.30	35.39	59.10	0.004	4.21	0.67	78.18	5.37	10.39	1.18	14190	13930	5.35
133	Lewis C. & C. Co.	Cabin Creek	A. D.	1.06	34.73	54.11	0.006	10.10	1.21	73.31	5.14	9.08	1.16	13400	13200	3.82
*133	Lewis C. & C. Co.	Cabin Creek		1.43	34.60	53.90	0.006	10.07	1.21	73.03	5.16	9.37	1.16	13350	13150	3.76
133A	Lackawanna Coal & Lumber Co.	Cabin Creek	A. D.	0.55	32.50	59.99	0.007	6.96	0.60	78.00	5.33	8.15	1.16	14139	14034	5.16
*133A	Lackawanna Coal & Lumber Co.	Cabin Creek		1.13	32.31	59.64	0.007	6.92	0.60	77.55	5.39	8.58	1.18	14057	13977	5.00
133B	Lackawanna Coal & Lumber Co.	Cabin Creek	A. D.	0.70	33.17	59.10	0.005	7.03	0.65	79.09	5.33	8.82	1.33	14045	13911	4.99
*133B	Lackawanna Coal & Lumber Co.	Cabin Creek		1.34	32.96	58.71	0.005	6.99	0.65	76.60	5.40	9.29	1.32	13955	13786	4.71
133C	Lackawanna Coal & Lumber Co.	Cabin Creek	A. D.	1.40	35.15	58.50	0.001	4.95	1.36	79.09	5.22	8.71	1.18	14329	14097	5.79
*133C	Lackawanna Coal & Lumber Co.	Cabin Creek		1.95	34.95	58.17	0.001	4.93	1.35	78.65	5.28	9.11	1.18	14249	14040	5.60

*Corrected for moisture.

Page Reference to Detailed Description and Section of Coal Opening and Mines Listed in Preceding Table.

Stockton-Lewiston Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
106	341	Virginia Coal Company	458
108A	.....	Perryville Coal Co.	459
113	361	Catherine Morris	461
113A	Bull. II, p. 284	Blue Creek Coal & Land Co.	462
118	Bull. II, p. 286, No. 5	National Bituminous Coal & Coke Co.	465
119	Bull. II, p. 286, No. 1	Dry Branch Coal Company	465
120	Bull. II, p. 286, No. 2	Wyatt Coal Co.	466
121	Bull. II, p. 286, No. 2	Wyatt Coal Co.	466
123	379	National Bituminous Coal & Coke Co.	467
124	Bull. II, p. 286, No. 4	Southern Collieries Co.	467
125	355	Allen Foster	467
133	367	Lewis Coal & Coke Company	470
133A	Bull. II, p. 283	Lackawanna C. & L Co. (Greenbrier No. 3)	470
133B	Bull. II, p. 283	Lackawanna C. & L Co. (Greenbrier No. 3)	...
133C	Bull. II, p. 284	Lackawanna Coal & Lumber Co. (Banner)	471

The Coalburg Coal.

The Coalburg coal is the next coal of economic importance below the Stockton-Lewiston seam, and is mined on a commercial scale in Kanawha county in Cabin Creek district; along the Kanawha river; on Kellys creek; on Cabin creek, and on Paint creek, and has been prospected in several of the other districts of Kanawha county.

CHARLESTON DISTRICT.

The Coalburg coal rises above the surface on the eastern edge of the district, along Wilson Branch, and was once mined at Black Hawk on the Charleston-Malden district line. It was probably this coal bed which was encountered at 90 feet in the well recently drilled by the Hotel Ruffner Company at the corner of Hale and Kanawha streets, for the elevator shaft.

and reported to be 3 feet thick, just above two feet of soft fire clay.

WASHINGTON DISTRICT.

The Coalburg bed comes to the surface near the southern part of Washington district. It is mined at Brounland on the Big Coal river, for local use, and crops in the railroad grade on Brier creek, but the bed is usually thin.

T. L. Broun Opening.—No. 134 on Map.

Located in Washington district, near Brounland.

	Thickness. Ft.	In.
Sandstone.		
Slate	2	0
Coal	2	10
Fire clay floor.		

The coal is mined for local use.

LOUDON DISTRICT.

The Coalburg coal rises above the C. & O. R. R. grade near the mouth of Lick Branch of Kanawha river, 1.2 mile east of the Charleston depot, where the following section is exposed:

	Thickness Ft.	In.			
Sandstone	10	0			
Bituminous slate	1	0			
Coal, hard, block	1	0			
Fire clay	0	2	....	3'	4"
Coal	0	2			
Fire clay. Elev. 611' A. T. B.	1	0			

This coal is mined on Middle Fork of Davis creek for local use by F. J. Hall:

F. J. Hall Opening.—No. 135 on Map.

Located in Loudon district, near head of Middle fork of Davis creek.

	Thickness Ft.	In.			
Sandstone roof	..	...			
Coal, impure	0	4			
Coal, block	1	2			
Bone	0	4	....	2′	5″
Coal, block	0	4			
Fire clay	0	3			

Sandstone floor; Elev. 831′ A. T. L.

G. W. & M. A. Peal Opening.—No. 136 on Map.

Located in Loudon district, 0.5 mile west of Marmet.

	Thickness Ft.	In.			
Sandstone roof	..	...			
Coal, cannel	1	1			
Shale and slate	2	5	....	6′	0″
Coal, cannel	2	6			

Slate floor; Elev. 1140′ A. T. B.

This opening is 85 feet under the **Kanawha Black Flint,** and 65 feet under the **Stockton-Lewiston coal** at this point. **The Coalburg coal** appears to be thin in the southern part of Loudon district as shown in the Hernshaw section on a previous page of this volume.

MALDEN DISTRICT.

The Coalburg coal has been mined on a commercial scale in Malden district, at Black Hawk, in the western part of this area:

The Perryville Coal Company of Malden is opening a mine on Campbell creek, in the Coalburg seam, and there the following section was measured:

Perryville Coal Company Mine No. 2.—No. 137 on Map.

Located in Malden district, 1.4 miles southeast of Five Mile station.

		Thickness Ft.	In.			
1.	Slate roof	..	...			
2.	Coal, block	1	6			
3.	Coal, semi-bituminous	0	6			
4.	Coal, block	0	2	....	3′	3″
5.	Slate	0	4			
6.	Coal, gas	0	9			
7.	Slate floor; Elev. 900′ A. T. B					

Samples were taken from Nos. 2, 3, 4 and 6 for analysis.

This bed comes 60 feet under the **Stockton-Lewiston coal** at this point.

Rosen Coal Company Opening.—No. 138 on Map.

Located in Malden district, ½ mile northeast of Snow Hill station.

	Thickness Ft.	In.			
Sandstone roof	..	...			
Coal, medium hard	2	1			
Slate	0	9	....	3′	3″
Coal	0	8			

Fire clay floor.

The top section of this coal appears to be a very good fuel coal.

W. D. Lewis Opening.—No. 139 on Map.

Located in Malden district, 1.5 miles due north of Dana, along county road leading from head of Valley branch of Campbells creek.

		Thickness Ft.	In.			
Sandstone		..	...			
1.	Coal	0	3			
2.	Slate	0	4			
3.	Coal, block	2	3	....	4′	8″
4.	Fire clay	0	9			
5.	Coal, block	1	1			

Fire clay floor; Elev. 890′ A. T. B.

Samples for analysis were taken from Nos. 3 and 5 of the section.

W. D. Lewis Opening.—No. 140 on Map.

Located in Malden district on Younger Branch of Campbell creek.

	Thickness Ft.	In.			
Sandy shale, bluish	7	0			
Coal, block	1	2			
Fire clay	1	6			
Coal, gas	0	10	....	5′	8″
Slate	0	1			
Coal, good	2	1			

Fire clay floor; Elev. 900′ A. T. B.

The opening was not fully driven under cover.

W. D. Lewis Opening.—No. 141 on Map.

Located in Malden district on Cline Branch of Campbell creek, 3 miles northeast of Coal Fork P. O.

	Thickness Ft.	In.			
Slate	..	...			
Coal, hard, block	0	10			
Slate	0	10			
Coal, hard, block	1	0			
Slate	0	3	....	4′	9″
Coal, block	0	6			
Slate	0	4			
Coal, block	1	0			

Fire clay floor; Elev. 840′ A. T.

The coal has been mined for local use. **The Kanawha Black Flint** crops here, 55 feet above this seam.

ELK DISTRICT.

The Coalburg coal comes out of Blue creek just west of Cocoa P. O., where the coal blossom appears in the railroad grade. The following section was measured at Sanderson P. O. on land of Blue Creek Coal & Land Company:

Blue Creek Coal & Land Co. Opening.—No. 142 on Map.

Located in Elk district at Sanderson, P. O.

	Thickness Ft.,	In.			
Sandstone	4	0			
Slate, bituminous	3	0			
Coal, hard	2	0	....	6′	0″
Fire clay	0	2			
Coal	0	10			

Fire clay floor; Elev. 740′ A. T. B.

The opening is driven in about 50 feet, and the coal appears irregular. **The Coalburg coal** has been mined for local use on Middle Fork of Blue creek at the mouth of Pond Fork, where the following section was measured:

Blue Creek Coal & Land Company Opening.—No. 143 on Map.

Located in Elk district on Middle Fork of Blue creek at mouth of Pond Fork.

	Thickness Ft.	In.			
Sandstone roof	..	...			
Coal	0	6			
Slate	0	2			
Coal	0	10			
Slate, black	0	2	....	3'	3"
Coal	0	9			
Slate	0	2			
Coal, visible; Elev. 900' A. T. B.	0	8			

The foregoing sections give the character and thickness of the **Coalburg coal** in Elk district.

CABIN CREEK DISTRICT.

Sunday Creek Company Opening.—No. 144 on Map.

Located in Cabin Creek district on Left fork of Witchers creek in Hunt hollow:

	Thickness Ft.	In.			
Sandstone, massive	..	...			
Coal	0	2			
Sandstone, blue	1	8			
Coal	0	1			
Sandstone	0	2			
Slate, black	0	2			
Coal	0	4	....	4'	10"
Slate, gray	0	1			
Coal	0	7			
Fire clay	0	6			
Bone	0	4			
Coal, visible; Elev. 1060' A. T. B.	0	9			

The coal comes 140 feet below the **Kanawha Black Flint** at this point.

On the Left Fork of Witchers creek, about one mile from the mouth of Hunt hollow, the **Coalburg coal** is mined for local use, and there the following measurement was obtained:

Sunday Creek Company Opening.—No. 145 on Map.

Located in Cabin Creek district, on Witchers creek one mile below the mouth of Hunt hollow.

	Thickness Ft.	In.			
Sandstone, massive	..	...			
Coal	0	2	}	3′	6″
Slate, gray	0	3			
Coal, block	3	1			

Fire clay floor; Elev. 1000′ A. T. B.

The coal comes 150 feet under the **Kanawha Black Flint** at this locality.

Hughes Creek Coal Company Mine No. 2.—No. 146 on Map.

Located in Cabin Creek district at Hugheston.

	Thickness Ft.	In.			
Sandstone, massive	..	...			
Slate, gray	1	7			
Coal, gray splint	2	7	}	4′	2″
Niggerhead	0	2			
Coal	1	5			

Fire clay floor; Elev. 1170′ A. T. B.
Butts, N. 10° W; Faces, N. 80° E.; Capacity, 600 tons daily.

Kellys Creek Colliery Co. Mine No. 1.—No. 147 on Map.

Located in Cabin Creek district on Fivemile Fork of Kelly creek.

	Thickness Ft.	In.			
Slate, bituminous (Free silver)	1	2			
Coal, gray splint	1	8			
Niggerhead	0	2			
Coal, gray splint	1	5			
Niggerhead	0	4			
Coal, splint	0	6	}	6′	0½″
Coal, gas	1	0			
Slate	0	½			
Coal, splint	0	9			
Coal, gas	0	2			

Fire clay floor; Elev. 1145′ A. T. B.
Butts, north; Faces, east.

The coal is used for domestic purposes and shipped west. Number of men employed, 70; daily capacity, 450 tons; Charles C. Gressang, Supt.

PLATE XXV.—Mine car loaded with Coalburg Coal from the mine of the Kelly Creek Colliery Company.

STANFORD LIBRARY

Kelly Creek Colliery Company Mine No. 3.—No. 148 on Map.

Located in Cabin Creek district on Kelly creek at Ward.

	Thickness Ft.	In.			
Sandstone	0	4			
Coal	0	4			
Slate	1	2			
Slate, bright "Free Silver"	0	4			
Coal, gray splint	1	6	....	7′	1½″
Niggerhead	0	2			
Coal, splint	1	3			
Niggerhead	0	½			
Coal, splint	2	4			

Fire clay floor; Elev. 1060′ A. T. B.

Butts, north; Faces, east. Coal used for domestic purposes and shipped west; Number of men employed, 230; Capacity, 1100 tons; Chas. C. Gressang, Supt.

Hughes Creek Coal Company Mine No. 3.—No. 149 on Map.

Located in Cabin Creek district, on west side of Sugar Camp Branch of Hughes creek.

Sandstone roof.	Thickness Ft.	In.			
Slate	8	12			
Coal, soft	0	5			
Coal, splint	0	5			
Coal, impure	0	2	....	5′	2″
Coal, splint	2	5			
Niggerhead	0	2			
Coal, splint	1	7			

Fire clay floors; Elev. 1100′ A. T. B.

Butts, N. 15° W.; Faces, N. 75° E.; capacity, 2,000 tons; coal shipped west for steam and domestic purposes.

The Coalburg coal is mined on the south side of Kanawha river at Handley and Crown Hill, by the Chesapeake Mining Company:

Chesapeake Mining Company Mine No. 2.—No. 150 on Map.

Located in Cabin Creek district, on Upper creek, one mile south of Handley.

	Thickness Ft.	In.			
1. Sandstone	..	...			
2. Slate	1	0			
3. Coal, gray splint	1	6			
4. Coal, gas	0	5	....	4′	7″
5. Coal, gray splint, hard	0	1			
6. Coal, splint	2	7			

7. Slate floor; Elev. 1190′ A. T. B.

Butts, N. 75° W.; Faces, N. 15° E.; coal shipped east and west for steam and domestic purposes.

The National Bituminous Coal & Coke Company (formerly the Pawnee Coal Company), also mines this bed at Crown Hill, where the following section was measured:

National Bituminous Coal & Coke Co., Black Cat Mine. No. 151 on Map.

Located in Cabin Creek district at Crown Hill.

		Thickness Ft.	In.			
1.	Coal, "rider"	0	2			
2.	Sandy slate	12	0			
3.	Coal, splint	0	10			
4.	Niggerhead	0	1			
5.	Coal, splint	0	8			
6.	Slate	0	5	....	6'	6"
7.	Coal, splint	2	1			
8.	Slate	0	9			
9.	Coal, gas; Elev. 1220' A. T. B.	1	8			

Butts, N. 70° W.; faces, N. 20° E. Coal shipped east and west for steam and domestic fuel.

This opening comes 60 feet under the **Stockton-Lewiston seam** at this point.

Winifrede Coal Company (Equitable Mine.)—No. 152 on Map.

Located in Cabin Creek district, one-half mile west of Crown Hill.

		Thickness Ft.	In.			
1.	Sandstone, massive	20	0			
2.	Slate	2	0			
3.	Coal, splint	0	3			
4.	Niggerhead	0	3			
5.	Coal, splint	2	10			
6.	Slate	0	½	....	5'	5"
7.	Coal, gas	0	8			
8.	Slate	0	½			
9.	Coal, gas with slate and sulphur beds	1	4			

10. Slate floor. Elev. 1230' A. T. B.

Samples for analysis taken from Nos. 3 and 5. The "gas" coal No. 9 is often left in the mine. Butts, N. 70° W.; faces, S. 20° E. Coal shipped east and west for steam and domestic use.

Across the hill on Cabin creek, the **Coalburg coal** is being mined on a commercial scale at several localities.

Dry Branch Coal Company Mine.—No. 153 on Map.

Located in Cabin Creek district, on Cabin Creek, at Dry Branch P. O., where the following section was obtained by Mr. Grout and published in Vol. II (A), West Virginia Geological Survey, page 450, 1908:

		Thickness Ft.	In.			
1.	Shale roof	..	..			
2.	Coal, soft	0	8			
3.	Niggerhead	0	3			
4.	Coal, soft	0	8			
5.	Coal, splint	0	4	....	7'	1"
6.	Coal, medium soft	2	2			
7.	Slate	1	0			
8.	Coal, gas	2	0			

9. Slate floor. Elev. 1130' A. T. B.

Butts, east; faces, north. Samples taken from No. 2, 4, 5 and 6 for analysis. Coal shipped by C. & O. railroad east and west for steam and domestic use.

Coalburg Colliery Company Mine No. 2.—No. 154 on Map.

Located in Cabin Creek district at Ronda:

		Thickness Ft.	In.			
1.	Sandstone	30	0			
2.	Slate	0	3			
3.	Coal, soft	0	10			
4.	Niggerhead	0	9			
5.	Coal, gray splint	4	0			
6.	Coal, gas	1	6	....	9'	9"
7.	Slate	1	0			
8.	Coal	1	8			
9.	Slate. Elev. 1100' A. T. B.	1	0			
10.	Sandstone	..	..			

Butts, N. 80° W.; faces, N. 20° E. Capacity, 400 tons per day. Coal shipped east and west for steam and domestic fuel.

The Wyatt Coal Company is mining the Coalburg coal on Paint Branch of Cabin creek at its mines Nos. 1 and 2.

Wyatt Coal Company, Horton Mine No. 2.—No. 155 on Map.

Located on Paint Branch of Cabin Creek, one mile southeast of Sharon.

		Thickness Ft.	In.			
1.	Slate	..	..			
2.	Coal, impure	2	6			
3.	Coal, cannel	0	4			
4.	Coal, hard, block	2	2	....	9'	0"
5.	Niggerhead	1	0			
6.	Coal, block	1	6			
7.	Coal, gas	1	6			

8. Slate floor. Elev. 1060' A. T. B.

Butts, N. 80° W.; faces, N. 10° E.

The cannel coal and the top layer, section No. 2, are usually left in the mine. The coal is shipped east and west for steam and domestic fuel.

Wyatt Coal Company, Horton Mine No. 1.—No. 156 on Map.

Located on south side of Paint Branch, south of Horton mine No. 2.; elevation 1075' A. T. B. The mine was idle when the writer visited this point. The coal shows practically the same thickness and character as in mine No. 1.

The Coalburg coal has been prospected at Eskdale and at Beth, but the bed is thin, and as the **Stockton-Lewiston coal** is thicker, the **Coalburg** has not been mined commercially at these points.

National Bituminous Coal & Coke Co. Mine No. 3. No. 157 on Map.

Located in Cabin Creek district at Eskdale:

		Thickness Ft.	In.
1.	Bituminous shale	4	0
2.	Slate	0	2
3.	Coal, hard, block	3	6
4.	Slate floor. Elev. 1380' A. T. B. Butts, N. 10° W.; faces, N. 18° E.		

This bed is 96 feet under the **Stockton-Lewiston coal** mined at this point.

The opening at Beth shows practically the same structure and thickness as the opening at Eskdale.

The Coalburg coal is mined at several localities on Paint creek by the Lackawanna Coal & Lumber Company.

Lackawanna Coal & Lumber Co., Wacomah Mine. No. 158 on Map.

In Cabin Creek district, on Paint Creek, at Wacomah, Ray V. Hennen measured the following section, published in Vol. II (A), page 454, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.
1.	Sandstone	..	..
2.	Slate .....1 ft. to 5	..	

		Thickness Ft.	In.			
3.	Coal, splint, good	1	3			
4.	Bone	0	1½			
5.	Coal, splint	1	0			
6.	Slate, black, hard	0	2			
7.	Coal, Cannel	1	5½	....	8′	1″
8.	Coal, semi-splint	0	9			
9.	Bone	0	1			
10.	Coal, splint	1	1			
11.	Coal, soft gas. Elev. 1165′ A. T. B...	2	2			

Butts, N. 30° W.; faces, N. 60° E. Coal shipped east and west for steam and domestic fuel. Samples taken from Nos. 8, 10 and 11 for analysis. Nos. 3, 4 and 5 are frequently left in the mine owing to the bad roof, thus losing several tons of coal per acre.

The stratum of **cannel coal,** No. 7, is separated in mining, and brings double the price of the other coal. A sample of it collected for analysis by Ray V. Hennen yielded the following results in the Survey laboratory as reported by Hite and Patton:

Proximate.	Per Cent
Moisture	0.25
Volatile Matter	41.35
Fixed carbon	46.27
Ash	12.13
Total	100.00
Sulphur	0.56
Phosphorus	0.01

Ultimate.	Per Cent.
Carbon	75.55
Hydrogen	5.56
Oxygen	5.25
Nitrogen	1.16
Sulphur	0.35
Ash	12.13
Total	100.00
Calorimeter B. T. U.	13919
Calculated B. T. U.	14042

Lackawanna Coal & Lumber Co. Scranton Mine.
No. 159 on Map.

Located in Cabin Creek district, on Paint Creek at Mucklow. Hennen made the following measurements here, as publishd in Vol. II (A), page 454, West Virginia Geological Survey, 1908:

				Thickness Ft.	In.
1.	Sandstone			..	..
2.	Slate, bluish, 4″ to			1	2
3.	Draw slate, fire clay			7	0
4.	Coal, splint	0′	8″		
5.	"Niggerhead"	0′	8″		
6.	Coal, "gas"	1′	4″		
7.	Coal, splint	1′	9½″	Coalburg Coal	
8.	Coal, "gas"	1′	11″	8	0½
9.	Slate	0′	10″		
10.	Coal, "gas"	0′	10″		

Butts, N. 30° W.; faces, N. 60° E. Coal shipped east and west for steam and domestic purposes. Samples taken from Nos. 3, 4 and 5 for analysis. Nos. 4 and 5 are both left to support roof.

Lackawanna Coal & Lumber Co. Paint Creek Mine. No. 160 on Map.

Located in Cabin Creek district on the west side of Paint Creek, just south of Mucklow:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Drawn slate	1	4			
3.	Coal, bony	0	4			
4.	Coal, hard, splint, fine	7	10	....	10′	0″
5.	Slate	0	8			
6.	Coal, soft	1	2			
7.	Slate floor. Elev. 1200′ A. T. B.					

Butts, N. 40° E.; faces, S. 50° E. Coal shipped east and west for steam and domestic purposes.

Lackawanna Coal & Lumber Co. Banner Mine. No. 161 on Map.

Located in Cabin Creek district, on Left-Hand Branch of Paint Creek, one mile southeast of Wacomah station:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Slate	1	0			
3.	Coal, hard, splint	6	2			
4.	Slate	0	9			
5.	Coal, soft, gas	0	8	....	9′	11″
6.	Slate ..... 2″ to 6″	..	4			
7.	Coal, soft	2	0			
	Fire clay floor. Elev. 1300′ A. T. B.					

Butts, N. 40° E.; faces, S. 50° E. Coal shipped east and west for steam and domestic purposes. Nos. 5 and 7 are left in the mine.

Standard Splint & Gas Coal Company Mine No. 1, West Side. No. 162 on Map.

Located in Cabin Creek district, on Paint Creek, at Standard P. O. The following section was measured by Hennen and published in Vol. II(A), West Virginia Geological Survey, page 456, 1908:

				Ft.	In.
1.	Sandstone			..	..
2.	Slate, black			1	0
3.	Coal, splint	3′	4″		
4.	Slate, black	0′	2″		
5.	Coal, Cannel (local)	0′	5″		
6.	Coal, semi-splint	0′	10″		
7.	Coal, hard, splint	1′	4″		
8.	Coal, semi-splint	0′	10″	Coalburg Coal	9	9½
9.	Slate	0′	½″			
10.	Coal, semi-splint	0′	10″			
11.	Slate, black	0′	6″			
12.	Coal, soft (not mined or exposed here)	1	6″			

Elevation (aneroid), 575 feet above railroad grade at Standard. Butts, N. 30° W.; faces, S. 60° E. Coal shipped east and west for local and domestic fuel. Samples taken for analysis from Nos. 3, 5, 6, 8 and 10.

Standard Splint & Gas Coal Company Mine No. 2. No. 163 on Map.

Located in Cabin Creek district, on east side of Paint Creek, at Standard P. O.:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Slate	0	8			
3.	Coal, block	2	3			
4.	Coal, Cannel	2	6	....	6′	3″
5.	Coal, visible. Elev. 1240′ A. T. B.	1	6			

Faces, N. 20° E.; butts, N. 70° W. The coal is shipped east and west for steam and domestic purposes.

This coal is not mined commercially, south of Standard on Paint creek. It rises rapidly to the southeast and at Detroit, two miles southeast of Standard, the coal appears near the tops of the hills where the following section was measured:

Lackawanna Coal & Lumber Co. Opening.—No. 164 on Map.

Located in Cabin Creek district, on Paint Creek, one-half mile west of Detroit P. O.:

	Thickness Ft.	In.			
Sandstone	..	..			
Shale	2	0			
Cannel slate	2	2	....	5′	2″
Coal, splint	3	1			

Fire clay floor. Elev. 1530′ A. T. B.

Butts, N. 70° W.; faces, N. 20° E. Coal shipped east and west for general fuel and domestic purposes.

The Coalburg coal was first mined at Coalburg, from whence it derives its name. The following is a section of the seam measured at its type locality:

Coalburg-Kanawha Coal Company Mine No. 1. No. 165 on Map.

Located in Cabin Creek district at Coalburg:

		Thickness Ft.	In.			
1.	Slate roof	..	..			
2.	Coal	0	9			
3.	Bone, Niggerhead	0	7			
4.	Coal	1	4			
5.	Bone	0	1	....	5′	8″
6.	Coal	0	11			
7.	Slate	0	3			
8.	Bone, Niggerhead	0	2			
9.	Coal	1	7			

10. Slate floor. Elev. 1125′ A. T. B.

Butts, N. 70° W.; faces, N. 20° E. Coal shipped east and west for steam and domestic use.

Winifrede Coal Company Mine.—No. 166 on Map.

Located in Cabin Creek district, on head of Dry Branch of Cabin Creek:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Slate	1	0			
3.	Coal, block	0	8			
4.	"Niggerhead"	0	7			
5.	Coal, splint	2	1	....	4'	9"
6.	"Niggerhead"	0	3			
7.	Coal, soft. Elev. 1140' A. T. B.	1	2			

Butts, N. 70° W.; faces, N. 20° E.

The coal is hauled through the hill and shipped by river and rail from Crown Hill, both east and west, for steam and domestic fuel.

The Quincy Coal Company Mine No. 1.—No. 167 on Map.

Located in Cabin Creek district, on west side of Kanawha River, one-half mile north of Quincy. Section taken by Mr. Frank F. Grout and published in Vol. II (A), page 447, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Slate roof	..	..			
2.	"Niggerhead"	0	4			
3.	Hard coal (sulphur balls)	0	5	....	3'	6"
4.	Soft coal	2	5			
5.	Hard coal	0	4			

6. Slate floor. Elev. 1010' A. T. B.

Butts, N.; faces, E. Coal shipped northwest for steam and domestic purposes.

It is quite a difficult matter to estimate the available area and tonnage of the **Coalburg coal** in Kanawha county, since the thickness of the bed is so variable as shown in the sections given on preceding pages of this report.

The writer has assumed that the coal is of commercial purity and thickness, in the southern part of Elk, in Malden and Cabin Creek districts, but while it is probable that there may be some available coal tonnage of this bed in other districts of Kanawha county, it has been deemed best not to attempt any tonnage estimates of the same.

A careful calculation of the area left uneroded, has been

made by Teets, with a planimeter, the results of which are given in the following table by magisterial districts, and figured on the basis of 25 cubic feet to the short ton, as with the Pittsburgh coal on page 416 of this report. The following results are obtained:

Table Showing Approximate Available Coalburg Coal.

District.	Sq. Mi.	Acres.	Thickness of Bed.	Cu. Ft. of Coal.	Short Tons of Coal.
Cabin Creek	60	38,400	5 ft.	8,363,520,000	334,540,800
Elk	10	6,400	3 ft.	836,352,000	33,454,080
Malden	16	10,240	4 ft.	1,784,217,600	71,368,704
Totals	86	55,040		10,984,089,600	439,363,584

The following table gives the comparative calorific value and fuel ratios of the **Coalburg coal** in Kanawha county:

Analyses of Coalburg Coal in Kanawha County

(Under the heading "Condition of Sample", "A. D."=Air dried; and "A. R."=As received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calculated B. T. U. for 1 lb. of coal.	Calorimeter B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
137	Perryville Coal Co.	Malden	A. R.	1.62	36.20	50.45	0.004	11.73	0.82	71.45	4.97	9.87	1.16	12950	12830	3.31
144	Sunday Creek Company	Cabin Creek	A. R.	0.56	35.74	56.84	0.004	6.86	0.86	....	....	....	....	13855	.....	....
146	Hughes Creek Coal Co., Mine No. 2	Cabin Creek	A. D.	1.07	34.74	57.45	0.003	6.74	0.63	78.32	5.99	7.67	0.83	13899	14564	5.43
147	Kellys Creek Colliery Co., Mine No. 1	Cabin Creek	A. D.	1.14	36.38	55.80	0.006	6.68	0.81	78.53	5.16	7.43	1.39	14040	14080	5.57
147	Kellys Creek Colliery Co., Mine No. 1	Cabin Creek	A. R.	1.36	36.30	55.68	0.006	6.66	0.81	78.36	5.17	7.60	1.39	14010	14050	5.49
148	Kellys Creek Colliery Co., Mine No. 3	Cabin Creek	A. D.	1.35	31.55	60.69	0.007	6.41	0.90	76.36	4.89	10.76	1.03	13903	13830	4.45
149	Hughes Creek Coal Co., Mine No. 3	Cabin Creek	A. D.	1.02	34.04	56.23	0.003	8.71	0.59	73.82	4.61	11.49	1.00	13587	12717	3.65
150	Chesapeake Mining Co., Mine No. 2	Cabin Creek	A. D.	1.00	31.34	59.32	0.006	8.34	0.77	77.59	4.24	7.98	1.08	13695	13326	4.76
*150	Chesapeake Mining Co., Mine No. 2	Cabin Creek		1.32	31.24	59.12	0.006	8.32	0.77	77.34	4.28	8.21	1.08	13651	13293	4.68
151	National Bituminous Coal & Coke Co.	Cabin Creek	A. D.	1.03	31.42	53.67	0.004	13.88	0.91	72.91	4.55	7.06	1.05	12625	12918	3.48
152	Winifrede Coal Co.	Cabin Creek	A. D.	0.83	35.37	57.60	0.001	6.20	0.76	79.11	5.67	7.32	1.20	13888	14309	5.85
152	Winifrede Coal Co., Equitable Mine	Cabin Creek	A. D.	0.80	34.25	56.10	0.004	8.85	1.43	74.18	5.22	9.69	1.16	13569	13352	4.06
153	Dry Branch Coal Co.	Cabin Creek	A. D.	1.19	36.56	56.03	0.001	6.22	0.66	75.68	5.67	10.87	1.17	14140	13700	4.43
154	Coalburg Colliery Co., Mine No. 2	Cabin Creek	A. D.	1.14	35.54	56.49	0.002	6.83	0.61	74.12	5.52	9.98	1.14	13664	13446	4.41
154	Coalburg Colliery Co., Mine No. 2	Cabin Creek	A. D.	1.25	32.87	57.16	0.003	8.72	0.69	74.89	5.75	8.99	1.20	13821	13784	4.23
156	Wyatt Coal Co., Horton Mine No. 2	Cabin Creek	A. D.	1.25	35.75	58.02	0.007	4.98	0.63	76.09	5.67	11.59	1.27	14567	13700	4.59
157	National Bituminous Coal & Coke Co., No. 3	Cabin Creek	A. D.	1.33	32.10	58.93	0.006	7.64	0.69	75.27	5.33	10.05	1.26	13613	13518	4.25

Analyses of Coalburg Coal in Kanawha County

(Under the heading "Condition of Sample", "A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
148	Kellys Creek Colliery Co., Mine No. 3.....	Cabin Creek.....	A. D.	1.07	37.42	57.74	0.003	3.77	0.85	79.81	5.56	8.54	1.47	14660	14430	6.48
148	Kellys Creek Colliery Co., Mine No. 3.....	Cabin Creek.....	A. R.	1.18	37.38	57.68	0.003	3.76	0.85	79.72	5.56	8.63	1.47	14650	14420	6.43
154	Coalburg Colliery Co., Mine No. 2.....	Cabin Creek.....	A. D.	0.52	35.78	56.84	0.005	6.86	0.86	.....	.....	.....	.....	14298	.....	.....
154	Coalburg Colliery Co., Mine No. 2.....	Cabin Creek.....	A. D.	0.69	35.66	58.43	0.004	5.22	0.93	.....	.....	.....	.....	14738	.....	.....
158	Lackawanna Coal & Lumber Co., Wacomah Mine	Cabin Creek.....	A. D.	1.30	33.95	59.19	0.010	5.56	0.91	79.09	5.56	7.72	1.16	14638	14392	5.96
*158	Lackawanna Coal & Lumber Co., Wacomah Mine	Cabin Creek.....		2.60	33.51	58.40	0.010	5.49	0.90	78.15	5.71	8.60	1.15	14445	14274	5.55
159	Lackawanna Coal & Lumber Co., Scranton Mine	Cabin Creek.....	A. D.	1.05	33.65	54.05	0.007	11.25	0.74	74.18	4.55	8.15	1.13	13368	13008	3.82
*159	Lackawanna Coal & Lumber Co., Scranton Mine	Cabin Creek.....		1.60	33.47	53.74	0.007	11.19	0.74	73.78	4.61	8.55	1.13	13295	12953	3.74
160	Lackawanna Coal & Lumber Co., Paint Cr. Mine	Cabin Creek.....	A. D.	1.00	34.30	58.08	0.008	6.62	0.71	78.82	5.11	7.79	0.95	14005	14060	5.47
*160	Lackawanna Coal & Lumber Co., Paint Cr. Mine	Cabin Creek.....		1.69	34.06	57.67	0.008	6.58	0.71	78.27	5.19	8.30	0.95	13909	13987	5.26
161	Lackawanna Coal & Lumber Co., Banner Mine.	Cabin Creek.....	A. D.	1.00	33.65	56.11	0.010	9.24	0.63	76.38	4.78	7.89	1.10	13885	13482	4.46
*161	Lackawanna Coal & Lumber Co., Banner Mine.	Cabin Creek.....		1.60	33.45	55.76	0.010	9.19	0.63	75.91	4.85	8.32	1.10	13802	13429	4.33
162	Standard Splint & Gas Co., Mine No. 1.....	Cabin Creek.....	A. D.	1.40	34.55	58.44	0.010	5.61	0.74	79.09	5.00	8.38	1.18	14289	13983	5.65
*162	Standard Splint & Gas Co., Mine No. 1.....	Cabin Creek.....		2.23	34.26	57.94	0.010	5.57	0.74	78.43	5.09	9.00	1.17	14169	13893	5.38
165	Coalburg-Kanawha Coal Co., Mine No. 1.....	Cabin Creek.....	A. D.	0.77	36.79	56.22	0.045	6.22	0.84	.....	.....	.....	.....	14051	.....	.....
167	The Quincy Coal Co., Mine No. 1.....	Cabin Creek.....	A. D.	1.07	32.63	60.10	0.003	6.20	1.09	77.05	4.94	9.93	1.18	13872	13454	4.78

*Corrected for Moisture.

Page Reference to Detailed Description and Section of Coal Openings and Mines Listed in Preceding Table.

Coalburg Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
137	376	Perryville Coal Co.	477
144	Vol. II, 550	Sunday Creek Co.	479
146	Bul. II, p. 285. No. 7.	Hughes Creek Coal Co. Mine No. 2.	480
147	362	Kellys Creek Colliery Co., Mine No. 1.	480
148	Bul. II, p. 285. No. 9	Kellys Creek Colliery Co., Mine No. 3.	481
149	Bul. II, p. 285. No. 8	Hughes Creek Coal Co. Mine No. 3.	481
150	Bul. II, p. 284. No. 14	Chesapeake Mining Co. Mine No. 2.	481
151	Bul. II, p. 285. No. 10	National Bituminous Coal & Coke Co.	482
152	Bul. II, p 285. No. 11	Winifrede Coal Co. Equitable Mine.	482
153	Bul. II, p. 285. No. 13	Dry Branch Coal Co.	483
*154	Bul. II, p. 285. No. 14	Coalburg Colliery Co. Mine No. 2.	483
†154	Bul. II, p. 285. No. 15	Coalburg Colliery Co. Mine No. 2.	483
156	Bul. II, p. 285. No. 16	Wyatt Coal Co. Horton Mine No. 2.	484
157	Bul. II, p. 285. No. 17	National Bituminous Coal & Coke Co. Mine No. 3.	484
154	Bul. II, p. 291. No. 4	Coalburg Colliery Co. Mine No. 2.	483
158	Bul. II, p. 284. No. 8	Lackawanna Coal & Lumber Co., Wacomah.	484
159	Bul. II, p. 284. No. 7	Lackawanna Coal & Lumber Co., Scranton.	485
160	Bul. II, p. 284. No. 9	Lackawanna Coal & Lumber Co., Paint Creek	486
161	Bul. II, p. 284. No. 10	Lackawanna Coal & Lumber Co., Banner.	486
162	Bul. II, p. 284. No. 11	Standard Splint & Gas Coal Co. Mine No. 1.	486
165	Bul. II, p. 291. No. 1	Coalburg Kanawha Coal Co. Mine No. 1.	487
167	Bul. II, p. 285. No. 6	The Quincy Coal Co. Mine No. 1.	488

*Splint coal only. †Gas coal only.

The next coal of economic importance below the Coalburg seam is the **Winifrede bed.** It very much resembles the Coalburg seam in quality as well as bed structure.

WASHINGTON DISTRICT.

The Winifrede coal is mined on Briar creek of Coal river by the Lackawanna Coal & Lumber Company and the Olcott Coal & Iron Company. The coal has been locally named the "Black Band" coal.

Lackawanna Coal & Lumber Co., Knickerbocker Mine. No. 168 on Map.

Located in Washington district on Briar creek, 1 mile above Olcott.

		Thickness Ft.	In.
1.	Sandstone	..	..
2.	Slate	0	2
3.	Coal, splint	0	4
4.	Coal, bony	0	3
5.	Coal, splint	2	7
6.	Fire clay floor. Elev. 950' A. T. B.		

Butts, N. 50° W.; faces, N. 40° E. Coal shipped east and west for steam and domestic purposes.

Lackawanna Coal & Lumber Co., Olcott Mine. No. 169 on Map.

Located in Washington district, on Brier creek, ¾ mile below the mouth of Spruce Fork, where Ray V. Hennen measured the section, published in Vol. II(A), page 440, West Virginia Geological Survey, 1908.

		Thickness Ft.	In.		
1.	Coal, Coalburg, in furnace shaft said to be clean	3	0		
2.	Concealed and sandstone	25	0		
3.	Slate 0" to	0	4		
4.	Coal, splint	0	6		
5.	Coal, splint, gray, hard	0	4		
6.	Coal, splint	2	2	..... 3'	6½'
7.	Slate 0" to	..	½		
8.	Coal, Splint, 3" to	..	6		

9. Slate floor. Elevation 860' A. T. B. (verified by Teets). Butts, N. 50° W.; faces, N. 40° E. Coal shipped east and west for steam and domestic purposes.

Lackawanna Coal & Lumber Company Opening. No. 170 on Map.

Located in Washington district on Brier Creek, just below Olcott.

		Thickness Ft.	In.			
1.	Sandstone and shale	..	..			
2.	Slate	1	9			
3.	Coal, splint	3	1			
4.	Slate	0	1	....	3′	8″
5.	Coal, soft	0	6			

6. Fire clay floor. Elev. 850′ A. T. B.
Butts, N. 50° W.; faces, N. 40° E.

Olcott Coal and Iron Company Mine No. 1.—No. 171 on Map.

Located in Washington district on Spruce Fork of Brier Creek.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, impure, splint	0	6	....	3′	5″
Coal, splint. Elev. 875′ A. T. B.	2	11			

Butts, N. 50° W.; faces, N. 40° E. Coal shipped east and west for steam and domestic purposes.

Lackawanna Coal & Lumber Company Opening. No. 172 on Map.

Located in Washington district on Brier creek, 1.4 miles southeast of Dungriff.

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Coal, splint	2	3			
3.	Coal, bony	0	6	....	3′	6″
4.	Coal, block	0	9			

5. Fire clay slate floor. Elev. 1010′ A. T. B.
Butts, N. 50° W.; faces, N. 40° E. Prospect opening.

Olcott Coal & Iron Company Mine No. 2.—No. 173 on Map.

Located in Washington district on Brier Creek at Olcott P. O.

		Thickness Ft.	In.			
1.	Slate	..	..			
2.	Coal, splint with streaks of gas coal	0	9	....	3′	11″
3.	Coal, splint	3	2			

4. Fire clay shale floor. Elev. 900′ A. T. B.
Butts, N. 50° W.; faces, N. 40° E. Coal shipped east and west for steam and domestic purposes.

D. G. Courtney Opening.—No. 174 on Map.

Located in Washington district on Wolfpen Branch of Brier Creek, 1.3 miles east of Brounland P. O.:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, gas	0	10			
Coal, impure	0	4	....	2'	8"
Slate, gray	0	2			
Coal, hard, visible. Elev. 725' A. T. B...	1	4			

Prospect opening driven in 6 feet.

D. G. Courtney Opening.—No. 175 on Map.

Located in Washington district on Meadow Fork of Brier Creek.

	Thickness Ft.	In.			
Coal blossom, Coalburg	..	..			
Sandstone and concealed	40	0			
Coal, impure	0	5			
Bone	0	4	....	3'	3"
Coal, impure	0	2			
Coal, splint. Elev. 730' A. T. B.....	2	4			

The coal is mined for local use.

LOUDON DISTRICT.

The Winifrede coal was formerly mined on Davis creek in Loudon district, and is known locally as the "Black Band Coal." At present no commercial mines operate this bed in Loudon district. The coal rises out of Davis creek below the mouth of Sugar Camp Branch.

Ault Land Company Opening.—No. 176 on Map.

Located in Loudon district on Davis Creek, one-half mile south east of Sugar Camp Branch.

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, block, good	2	7
Sandstone	1	4
Slaty shale. Elev. 735' A. T. B.....	2	0

Prospect opening.

James Conner Opening.—No. 177 on Map.

Located on Davis Creek, 1.2 miles southeast of mouth of Sugar Camp Branch:

	Thickness Ft.	In.
Sandstone, massive	..	..
Slate, gray	0	2
Coal, block	3	3

Sandstone floor. Elev. 780′ A. T. B.

The coal is mined for local use.

Black Band Coal & Coke Company, Mine No. 2. No. 178 on Map.

Located in Loudon district near Chilton. Measurement taken by Mr. Ray V. Hennen and published in Vol. II (A), page 437, West Virginia Geological Survey, 1908:

	Thickness Ft.	In.		
Sandstone, good roof	..	..		
Coal, gray splint	0	8		
Coal, semi-splint, bright	0	9	....	2′ 7″
Coal, gray splint, hard	0	1		
Coal, semi-splint, bright	1	1		

Slate. Elev. 900′ A. T. B.

Butts, N. 50° W.; faces, N. 40° E. This mine has been abandoned.

Black Band Coal & Coke Company Opening. No. 179 on Map.

Located on east side of Davis Creek, near mouth of Shrewsbury hollow:

	Thickness Ft.	In.
Sandstone, massive	..	..
Coal, block. Elev. 830′ A. T. B.	2	4
Sandstone, massive, floor.		

Black Band Coal & Coke Company Opening. No. 180 on Map.

Located in Loudon district on west side of Davis Creek, near mouth of Shrewsbury hollow:

	Thickness Ft.	In.
Sandstone, massive, roof	..	..
Coal, good, block. Elev. 825′ A. T. B.	2	2
Sandstone, massive, floor.		

PLATE XXVI.—Winifrede Coal in mine of Carbon Coal Company, South Carbon mine.

CLAYTON LIBRARY

Black Band Coal and Coke Company Prospect Opening. No. 181 on Map.

Located in Loudon district in Polly hollow of Davis Creek, one mile west of Chilton P. O.:

	Thickness Ft.	In.
Sandstone, roof	..	..
Coal, block. Elev. 860' A. T. B	3	2

Sandstone floor.

Black Band Coal & Coke Co. Mine No. 3.—No. 182 on Map.

Located in Loudon district on east side of Davis Creek, near mouth of Shrewsbury hollow. Measurement taken by Ray V. Hennen and published on page 438, Vol. II (A), West Virginia Geological Survey:

	Thickness Ft.	In.		
Slate .....4 in. to	..	6		
Coal, gray splint	0	6		
Coal, semi-splint, bright	0	9	....	2' 6"
Coal, gray splint, hard	0	1		
Coal, semi-splint, bright	1	2		

Black slate. Elev. 880' A. T. B.

Butts, N. 50° W.; faces, N. 40° E. Mine abandoned.

Davis Creek Mining Company Opening.—No. 183 on Map.

Located in Loudon district on Davis Creek, 2 miles below Chilton P. O.:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, hard, block	2	6

Sandstone floor. Elev. 733' A. T. B.

Butts, N. 50° W.; faces, N. 40° E. Mine abandoned.

Black Band Coal & Coke Prospect Opening.—No. 184 on Map.

Located in Loudon district on Cain Fork of Davis Creek, 1.2 miles from its mouth:

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Slate	2	0		
Coal	0	1		
Fire clay	1	0	....	3' 1"
Coal, hard, block. Elev. 745' A. T. B.	2	0		

D. G. Courtney Opening.—No. 185 on Map.

Located in Loudon district, on Long Branch of Cain Fork of Davis Creek.

	Thickness Ft.	In.			
Slate	2	0			
Coal, impure	1	0			
Coal, gas	0	8	....	3′	2″
Coal, hard, block. Elev. 780′ A. T. B....	1	6			

The coal is mined by Daniel Pridemore for local use.

D. G. Courtney Opening.—No. 186 on Map.

Located in Loudon district on Chapel Branch, 1.5 miles northwest of Malden:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, hard, block	0	6			
Slate	0	4	....	2′	10″
Coal, good	2	0			

Fire clay floor. Elev. 810′ A. T. B.

The coal is mined by Confucious Pittard for local use.

Black Band Coal & Coke Company Opening.—No. 187 on Map.

Located in Loudon district on Kanawha Fork of Davis Creek at mouth of Middle Lick Branch:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	1	1			
Coal	0	4			
Bone	0	4	....	3′	10″
Slate	0	8			
Coal, hard block	2	6			

Fire clay floor. Elev. 800′ A. T. B.

Butts, N. 50° W.; faces, N. 40° E. Mine abandoned.

J. G. Wiseman Opening.—No. 188 on Map.

Located in Loudon district, on Donley Branch of Kanawha River, 1.4 miles northwest of Malden.

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal	0	8			
Slate	0	10	....	3′	6″
Coal, block. Elev. 810′ A. T. B.....	2	0			

The coal has been mined for local use on Donley Branch for more than 50 years, and during the Salt Industry period on the Kanawha river, the coal was hauled on a narrow gauge railroad from the mine to the river.

Black Band Coal & Coke Company Opening.—No. 189 on Map.

Located in Loudon district, on north side of Rush Creek, 2 miles northwest of Marmet:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, impure	1	0			
Slate	0	6	....	4′	0″
Coal, splint	2	6			

Sandstone floor. Elev. 980′ A. T. B.
This coal is mined for local use.

Low & Butler Opening.—No. 190 on Map.

Located in Loudon district, on Right Fork of Left Fork of Lens Creek. Opening made by James Guard of Charleston, and exhibits the following section:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, block	2	8			
Slate	0	2	....	3′	10″
Coal, block. Elev. 1307′ A. T. B.	1	0			

The coal lies 360 feet below the base of a hard conglomerate sandstone which is possibly the East Lynn bed.

CHARLESTON DISTRICT.

The Winifrede coal was once mined near the eastern corporation limits of the city of Charleston, in Wilson hollow, by Mathew Wilson, who reports the following section:

Mathew Wilson Opening.—No. 191 on Map.

Located in Charleston district in Wilson hollow:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Coal, soft	0	4			
Niggerhead	0	2			
Coal, hard, splint	1	6	....	5′	4″
Shale and slate, gray	1	6			
Coal, soft	0	10			

Elev. 620′ A. T. B.

This coal comes 149 feet L. below the base of the **Kanawha Black Flint** at this point, and was locally known as the **"Brooks" vein.**

MALDEN DISTRICT.

The Winifrede bed has not been opened at many points in Malden district, since the coal appears to be thin in that area.

W. D. Lewis Opening.—No. 192 on Map.

Located in Malden district on north side of Eight-Mile Fork of Campbell Creek, one-half mile from its mouth:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	1	3			
Coal, hard, block	1	0			
Slate	0	6	....	2′	8″
Coal, hard, block. Elev. 790′ A. T. B.	1	2			

The coal has been mined for local use.

Black Hawk Coal Co. Mine.—No. 193 on Map.

Located in Malden district, Black Hawk Hollow, one mile northeast of Snow Hill:

	Thickness Ft.	In.			
Sandstone	..	..			
Niggerhead	0	2			
Coal, splint, hard	1	6			
Slate, dark	0	1	....	5′	0″
Coal, hard, splint	0	10			
Slate, dark	0	5			
Coal, soft, "gas"	2	0			

The coal is mined for local fuel and transported from the mine on wagons.

CABIN CREEK DISTRICT.

The Winifrede coal is being mined at several different points in Cabin Creek district, on the south side of the Kanawha river and its tributaries. On the north side of the river

it appears not to have attained a thickness to warrant much mining on a commercial scale.

Sunday Creek Coal Opening.—No. 194 on Map.

Located in Cabin Creek district, on Witchers Creek, 3 miles north of Cedar Grove:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate, gray	0	2			
Coal, splint	0	5	}	....	2′ 5″
Slate, gray	0	1			
Coal, splint	1	11			

Slate floor Elev. 950′ A. T. B.

The coal is mined for local fuel use by M. D. Martin, and the bed comes 185 feet below the **Kanawha Black Flint** at this point.

Quincy Coal Company Mine.—No. 195 on Map.

Located in Cabin Creek district, on Carroll Branch, one-half mile northeast of Quincy:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	1	6			
Coal, impure	0	5	}	....	3′ 5″
Coal, splint. Elev. 980′ A. T. B.	3	0			

New Diamond Mining Company Mine.—No. 196 on Map.

Located in Cabin Creek district, on north side of Kanawha River, three-fourths mile west of Quincy:

	Thickness Ft.	In.			
Sandstone	..	..			
Niggerhead	0	5	}	....	3′ 9″
Coal, splint	3	4			

Slate floor. Elev. 960′ A. T. B.

Butts, N. 60° W.; faces, N. 30° E. Mine abandoned, but not all of the coal exhausted.

Hughes Creek Coal Company Mine.—No. 197 on Map.

Located in Cabin Creek district, on north side of Hughes Creek, just north of Sugar Camp Branch. Coal reported four feet thick. Elevation 970′ A. T. B.

The coal was once mined here by Hughes Creek Coal Company, but the opening is now abandoned. The bed comes 115 feet under the **Coalburg coal Mine No. 3** of the same company.

The Eureka Coal Company Mine No. 3.—No. 198 on Map.

Located in Cabin Creek district, on Morris creek, ½ mile south of Donwood.

	Thickness Ft.	In.		
Sandstone	..	..		
Slate, black	0	2		
Coal	0	1		
Slate	0	3		
Coal, semi-splint	0	7		
Slate	0	2	....	5' 6"
Coal, splint	2	7		
Slate, gray	0	2		
Coal, splint	1	0		
Coal gas. Elev. 1275' A. T. B.	0	6		

Butts, N. 80° W.; faces, N. 10° E. Coal shipped east and west for domestic fuel. The coal comes 240 feet under the **Kanawha Black Flint.**

Montgomery Coal Company Mine.—No. 199 on Map.

Located in Cabin Creek district on Upper Creek, 2½ miles southeast of Handley:

	Thickness Ft.	In.		
Sandstone	..	..		
Slate	0	8		
Coal, splint	3	0		
Slate, gray	0	6		
Coal, semi-splint	0	5	....	6' 1"
Sandstone, black, from 3" to	0	9		
Coal, splint, hard. Elev. 1165' A. T. B.	1	5		

Butts, N. 70° W.; faces, N. 20° E. The coal is shipped east and west for steam and domestic purposes.

A hard splint coal often occurs from 10 to 20 feet underneath this bed in this locality.

On Cabin Creek the Winifrede coal is not mined until near the head of the stream. A prospect opening, on Coal Fork of Cabin creek, on land of LaFolette et al., shows as follows:

LaFolette et al. Opening.—No. 200 on Map.

Located in Cabin Creek district, on head of Coal Fork of Cabin Creek:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, impure	0	10	....	5′	2″
Coal, block	4	4			

Slate floor. Elev. 1200′ A. T. B.

The coal has been mined for local use at this point.

LaFolette et al. Opening.—No. 201 on Map.

Located in Cabin Creek district on head of Coal Fork, one-half mile south of opening 200.

		Thickness Ft.	In.			
1.	Slate roof	..	..			
2.	Coal, good	0	1			
3.	Coal, impure	1	0			
4.	Coal, block	2	6	....	6′	3″
5.	Slate	0	1			
6.	Coal, block, vis. Elev. 1230′ A. T. B.	2	6			

No. 6 is reported to be 3 feet thick. The coal has been mined for local use.

On Tenmile Fork of Cabin creek, what appears to be the **Winifrede coal** has been mined for some years at Acme and Kayford, and is known locally as the "Acme" seam in this region.

Cabin Creek Consolidated Coal Co. (Acme Mine). No. 202 on Map.

Located in Cabin Creek district at Acme.

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, splint	4	6			
Slate	0	0½	....	5′	6″
Coal, splint. Elev. 1790′ A. T. B.	0	11½			

Butts. N 15° W; Faces, N 75°. Coal shipped east and west for steam and domestic purposes.

Cabin Creek Consolidated Coal Co. (Rose Mine). No. 203 on Map.

Located in Cabin Creek district, one-half mile north of Kayford:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, soft	0	8			
Coal, hard	0	4	....	6'	0"
Coal, block	3	4			
Coal, splint	1	8			

Slate floor.

Butts, N 15° W; Faces, N 75° E.

This coal is shipped east and west, and coal lies 472.5 feet spirit level above the **No. 2 Gas coal,** which is mined at the No. 2 Thistle mine.

Cabin Creek Consolidated Coal Co. (Raccoon No. 1 West Side).—No. 204 on Map.

Located in Cabin Creek district, one mile south of Kayford:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Slate	0	3			
Coal, splint	4	3			
Coal, soft	0	10	....	6'	0"
Slate	0	1			
Coal	0	10			

Slate floor. Elev. 1775' A. T. B.

Butts, N. 15° W.; faces, N. 75° E.

The coal is shipped east and west.

Cabin Creek Consolidated Coal Co. (Raccoon Mine No. 2, East Side).—No. 205 on Map.

Located in Cabin Creek district, one mile south of Kayford:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, soft	0	8			
Coal, hard	4	4	....	7'	2"
Slate	0	2			
Coal, soft. Elev. 1782' A. T. L.	2	0			

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and domestic purposes.

Cabin Creek Consolidated Coal Co. (United Mine). No. 206 on Map.

Located in Cabin Creek district, on Fifteen-Mile Fork of Cabin Creek at Wevaco:

	Thickness Ft.	In.		
Sandstone	..	..		
Coal, splint	4	9		
Slate	0	1	....	6′ 0″
Coal, splint	1	2		

Slate floor. Elev. 1937′ A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

The coal is shipped east and west for steam and domestic purposes, and comes 477 feet spirit level above the **No. 2 Gas coal** at this point.

Cabin Creek Consolidated Coal Co. (Ruby Mine). No. 207 on Map.

Located in Cabin Creek district at Decota:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, block	5	2

Slate floor. Elev. 1894′ A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal is shipped east and west for steam and domestic purposes.

West Virginia Colliery Co. Mine No. 3.—No. 208 on Map.

Located in Cabin Creek district, on head of Fifteen-Mile Fork of Cabin Creek, one mile southeast of Wevaco:

	Thickness Ft.	In.		
Sandstone roof	..	..		
Coal, block	5	5		
Slate	0	2	....	7′ 2″
Coal, soft	1	7		

Slate floor. Elev. 2047′ A. T. L.

The coal comes 517 feet above the top of the **No. 2 Gas coal** at this point, and this interval is evidently thickening southward.

Republic Coal Co. Mine No. 5.—No. 209 on Map.

Located in Cabin Creek district, on Cabin Creek at Republic:

		Thickness Ft.	In.			
1.	Sandstone	..	..			
2.	Coal, block	1	6			
3.	Slate	4	0			
4.	Coal, block	1	6	....	16′	0″
5.	Slate and fireclay	4	0			
6.	Coal, hard, block. Elev. 2100′ A. T. B.	5	0			

7. Sandstone.

Butts, N. 15° W.; faces, N. 75° E. No. 6 is the only portion of the bed mined, the rest of the coal being left.

The coal is shipped east and west for steam and domestic purposes.

Carbon Coal Co. (Splint Mine).—No. 210 on Map.

Located in Cabin Creek district at Carbon:

	Thickness Ft.	In.			
Sandstone	..	..			
Coal, splint	4	10			
Slate	0	1	....	6′	1″
Coal, soft	1	2			

Sandstone floor. Elev. 1910′ A. T. B.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and domestic purposes.

Slaughter Creek Coal & Land Co., Prospect Opening. No. 211 on Map.

Located in Cabin Creek district, on Slaughter Creek at mouth of Bradley Fork:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, splint	1	8			
Slate	0	3	....	4′	0″
Coal, splint	2	1			

Fire clay floor.

Slaughter Creek Coal & Land Co. Opening.—No. 212 on Map.

Located in Cabin Creek district, on Dotson Fork of Slaughter Creek:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	1	5			
Coal, medium hard	1	1			
Slate, gray	0	2			
Coal, block	1	4	....	7′	0″
Slate, gray	1	4			
Coal, soft	1	1			
Coal, hard, block, vis. Elev. 1025′ A. T. B.	2	0			

Prospect opening driven about 5 feet under cover.

Slaughter Creek Coal & Land Co.—No. 213 on Map.

Located in Cabin Creek district on Slaughter Creek, 0.7 miles south of mouth of Dotson Fork:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	3	0			
Coal	0	5			
Slate	0	3			
Coal	0	7	....	2′	5″
Slate	0	1			
Coal	1	1			

Slate floor. Elev. 1035′ A. T. B.

The three following measurements at the town of Winifrede were made by R. W. Edmonds in 1902, and published on page 557, Volume II, W. Va. Geol. Survey, 1903:

Winifrede Coal Co. (South Mine).—No. 214 on Map.

Located in Cabin Creek district at Winifrede:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	0	1			
Coal	0	10			
Coal, gray, splint	0	4			
Coal, block	1	6	....	5′	7″
Coal, impure	0	6			
Slate, gray	0	6			
Coal, splint. Elev. 1035′ A. T. B.	1	11			

Butts, N. 26½° W.; faces, N. 63½° E.

Coal shipped east and west for local and steam purposes.

Winifrede Coal Co. (North Mine).—No. 215 on Map.

Located in Cabin Creek district, one mile south of Winifrede:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	2	0			
Coal, block	1	2			
Coal, gray splint	0	4½			
Coal, block	1	4	....	4′	8½″
Slate	0	4			
Coal, splint	1	6			

Elev. 1030′ A. T. B.

Butts, N. 26½° W.; faces, N. 63½° E.

Coal shipped east and west for steam and domestic purposes.

Winifrede Coal Co. (Machine Mine).—No. 216 on Map.

Located in Cabin Creek district, one mile southwest of Winifrede:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	1	0			
Coal, splint	0	10			
Bone	0	2			
Coal, splint	1	1	....	4′	3″
Slate	0	4			
Coal, block	1	10			

Slate floor. Elev. 1075′ A. T. B.

Butts, N. 26½° W.; faces, N. 63½° E.

Coal shipped east and west for steam and domestic purposes.

Mr. W. D. Ord, a mining engineer from McDowell county, W. Va,. has recently made an examination and reported on a tract of several thousand acres, known as the Low and Butler lands, located between Fields and Lens creeks in Cabin Creek and Loudon districts, and a copy of the report has been given the writer by Mr. Jas. Guard of Charleston, W. Va.

The measurements of the following three openings, lo-

cated in Cabin Creek district, have been copied from this report:

Low & Butler Opening.—No. 217 on Map.

Located on Fields Creek, one-half mile southwest of Winifrede:

	Thickness Ft.	In.			
Slate	..	..			
Coal, splint	2	4			
Slate	0	2	....	4′	3″
Coal	1	9			

Slate floor Elev. 1076′ A. T. B.

Low & Butler Opening.—No. 218 on Map.

Located on Fields Creek just west of Winifrede P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, splint	2	6			
Slate	0	0½	....	4′	3½″
Coal, splint. Elev. 1088′ A. T. B.	1	9			

Low & Butler Opening.—No. 219 on Map.

Located one-half mile northwest of Winifrede P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	1	10			
Slate	0	6	....	3′	6″
Coal	1	2			

Slate floor. Elev. 1081′ A. T. B.

The available area and tonnage of the Winifrede coal in Kanawha county is very difficult to determine. From the sections given on the preceding pages it will be observed that the thickness of the seam varies from 2 feet 3 inches to 7 feet. The coal also varies in different localities in both character and structure, and its occurrence seems to be patchy. The writer has assumed the coal to be of thickness and purity to be of commercial value in the following magis-

terial districts in Kanawha county, the results of which are given in the following table, assuming that 25 cubic feet of coal will equal a short ton as with the Pittsburgh coal on a previous page of this report:

Table Showing Approximate Available Winifrede Coal.

DISTRICTS.	Sq. Miles	Acres	Thickness of bed Ft.	Thickness of bed In.	Cubic feet of Coal	Short tons of Coal.
Cabin Creek	40	25,600	4	6	5,018,112,000	200,724,440
Charleston	1	640	2	8	74,323,814	2,972,952
Loudon	8	5,120	2	8	594,563,855	23,782,554
Malden	6	3,840	3	3	543,628,800	21,745,152
Washington	4	2,560	3	3	362,419,200	14,526,768
Totals	59	37,760			6,593,047,669	263,751,896

The following table gives the comparative calorific value and fuel ratio of the coal in the Winifrede bed in Kanawha county:

Analyses of Winifrede Coal in Kanawha County.

(Under the heading "Condition of Sample", "A. D."=Air dried; and "A. R."=As received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.					Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
168	Lackawanna C. & L. Co., Knickerbocker Mine.	Washington	A.D.	1.55	34.85	56.49	0.007	7.11	0.50	76.92	4.73	9.50	1.24		13875	13401	4.63
*168	Lackawanna C. & L. Co., Knickerbocker Mine	Washington		1.83	34.75	56.33	0.007	7.09	0.50	76.71	4.76	9.70	1.24		13826	13378	4.57
171	Olcott Coal & Iron Co., Mine No. 1.....	Washington	A.D.	1.55	35.31	56.36	0.008	6.78	0.68	76.39	4.89	10.03	1.23		13803	13391	4.54
*171	Olcott Coal & Iron Co., Mine No. 1.....	Washington		1.74	35.25	56.24	0.008	6.77	0.68	76.25	4.91	10.16	1.23		13777	13386	4.50
173	Olcott Coal & Iron Co., Mine No. 2.....	Washington	A.D.	1.70	35.54	55.69	0.005	7.07	0.67	74.77	4.74	11.59	1.16		13369	12943	4.01
*173	Olcott Coal & Iron Co., Mine No. 2.....	Washington		1.92	35.46	55.56	0.005	7.06	0.67	74.61	4.77	11.73	1.16		13340	12926	3.97
175	D. G. Courtney	Washington	A.R.	1.20	41.66	54.41	0.004	2.73	0.70	.....	.....	.....	.....		.....	.....	.....
176	Black Band Coal & Coke Co.....	Loudon	A.R.	1.04	42.27	54.45	0.006	2.24	0.67	.....	.....	.....	.....		.....	.....	.....
177	James Conner	Loudon	A.R.	0.96	41.37	55.29	0.001	2.38	0.71	.....	.....	.....	.....		.....	.....	.....
178	Black Band Coal & Coke Co., Mine No. 2....	Loudon	A.D.	2.25	35.55	55.78	0.003	6.42	0.53	75.75	4.66	11.47	1.17		13300	13041	4.23
*178	Black Band Coal & Coke Co., Mine No. 2....	Loudon		2.33	35.52	55.73	0.003	6.42	0.53	75.69	4.67	11.52	1.17		13290	13032	4.22
182	Black Band Coal & Coke Co., Mine No. 3....	Loudon	A.D.	1.80	35.70	55.16	0.003	7.34	0.68	75.97	4.68	10.13	1.20		13690	13181	4.35
183	Davis Creek Mining Co.....	Loudon		1.08	37.69	55.48	0.004	5.75	0.66	.....	.....	.....	.....		.....	.....	.....
185	D. G. Courtney	Loudon	A.R.	1.34	42.67	53.11	0.004	2.88	0.62	.....	.....	.....	.....		.....	.....	.....
193	Black Hawk Coal Co.....	Loudon		1.67	38.10	54.48	0.005	5.75	0.50	.....	.....	.....	.....		.....	13877	.....
196	New Diamond Mining Co.....	Cabin Creek		0.56	38.64	57.67	0.003	3.13	0.77	.....	.....	.....	.....		14844	.....	.....
198	Eureka Coal Co., Mine No. 3.....	Cabin Creek	A.D.	0.80	34.25	60.56	0.007	4.39	0.95	79.09	5.56	9.14	1.22		14506	14286	5.85
*198	Eureka Coal Co., Mine No. 3.....	Cabin Creek		1.50	34.01	60.13	0.007	4.36	0.95	78.54	5.64	9.65	1.21		14405	14195	5.61
199	Montgomery Coal Co.	Cabin Creek	A.D.	0.75	34.45	60.87	0.003	3.93	0.72	81.41	4.65	7.96	1.33		14336	14141	6.85
*199	Montgomery Coal Co.	Cabin Creek		0.94	34.39	60.75	0.003	3.92	0.72	81.26	4.67	8.10	1.33		14308	14117	6.76
203	Cabin Creek Cons. Coal Co., Rose Mine.....	Cabin Creek	A.D.	1.45	27.85	63.41	0.007	7.29	0.63	76.91	4.67	9.47	1.26		13939	13377	4.59
206	Cabin Creek Cons. Coal Co., United Mine....	Cabin Creek	A.D.	1.35	29.65	63.25	0.005	5.75	0.67	80.50	5.00	7.11	1.24		14362	14278	6.26
208	West Va. Colliery Co., Mine No. 3.....	Cabin Creek	A.D.	1.85	30.55	62.21	0.006	5.39	0.66	79.76	4.91	7.96	1.32		14106	14052	5.97
*208	West Va. Colliery Co., Mine No. 3.....	Cabin Creek		2.08	30.48	62.06	0.006	5.38	0.66	79.58	4.93	8.13	1.32		14075	14026	5.89
215	Winifrede Coal Co., North Mine.....	Cabin Creek		1.09	36.59	58.42	0.003	3.90	0.65	.....	.....	.....	.....		14347	.....	.....
216	Winifrede Coal Co., Machine Mine.....	Cabin Creek		1.02	36.05	58.34	0.003	4.59	0.69	.....	.....	.....	.....		14435	.....	.....
216A	Winifrede Coal Co., Machine Mine.....	Cabin Creek	A.R.	1.51	36.64	56.04	0.006	5.81	0.69	.....	.....	.....	.....		.....	.....	.....

*Corrected for Moisture.

Page Reference to Detailed Description and Section of Coal Openings and Mines Listed in Preceding Table.

Winifrede Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
168	Bul. II, p. 284. No. 30	Lackawanna Coal & Lumber Co. Knickerbocker Mine	493
171	Bul. II, p. 284. No. 29	Olcott Coal & Iron Co. Mine No. 1	494
173	Bul. II, p. 284. No. 31	Olcott Coal & Iron Co. Mine No. 2	494
175	331	D. G. Courtney	495
176	323	Ault Land Company	495
177	325	James Conner	496
178	Bul. II, p. 284. No. 27	Black Band Coal & Coke Co. Mine No. 2	496
182	Bul. II, p. 284. No. 26	Black Band Coal & Coke Co. Mine No. 3	497
183	Bul. II, p. 287. No. 9	Davis Creek Mining Co	497
185	322	D. G. Courtney	498
193	Vol. II, p. 550	Black Hawk Coal Co	500
196	Bul. II, p. 287. No. 5	New Diamond Mining Co	501
198	Bul. II, p. 285. No. 34	Eureka Coal Co	502
199	Bul. II, p. 284. No. 33	Montgomery Coal Co	502
203	Bul. II, p. 285. No. 18	Cabin Creek Cons. Coal Co. Rose	504
206	Bul. II, p. 285. No. 19	Cabin Creek Cons. Coal Co. United	505
208	Vol. II(A), p. 466. No. 13	West Va. Colliery Co. Mine No. 3	505
215	Bul. II, p. 287. No. 2	Winifrede Coal Co. North Mine	508
216	Bul. II, p. 287. No. 3	Winifrede Coal Co. Machine Mine	508

Mr. J. C. Jenkins of Kayford, W. Va., analyst for the Cabin Creek Consolidated Coal Company, has taken samples of the coals shipped by said company for the past five years and has made repeated analyses of same. The following table shows the average results of his work.

Analysis of Winifrede Coal from Mines of Cabin Creek Consolidated Coal Company, Made by J. C. Jenkins, Analyst.

Map No.		Mois.	V. M.	F. C.	Ash	Sul.
205	Raccoon No. 2 (East)	0.69%	33.25%	60.23%	5.93%	0.60%
204	Raccoon No. 2 (West)	0.63%	32.96%	58.01%	8.40%	0.63%
203	Rose	0.68%	33.69%	59.33%	6.30%	0.63%
207	Ruby	0.80%	34.83%	58.92%	5.45%	0.47%
206	United No. 2.....	0.74%	34.03%	59.51%	5.72%	0.55%
202	Acme	0.70%	33.79%	59.66%	5.85%	0.60%
Aver.		0.71%	33.76%	59.42%	6.11%	0.51%

B. T. U. (dry) 14,645

The Chilton Coal.

From the sections already given in this volume it will be noted that the Chilton bed is thin and at the present time has no economic or commercial value; so no attempt will be made to estimate the available coal in this bed.

The Thacker Coal.

What would appear to represent the Thacker coal is mined on Lens creek by the Marmet Coal Co., and has been called the "Block seam." It attains its best development on Lens and Fields creeks, or rather, between these two creeks, in Loudon and Cabin Creek districts.

The Marmet Coal Company Mine No. 3 (Old). No. 220 on Map.

Located in Loudon district, ½ mile south of Hernshaw P. O.:

	Thickness Ft.	In.
Slate roof.		
Coal, block	2	10
Slate floor; Elev. 940' A. T. B.		

Butts. N 30° W; Faces, N 60° E.

Coal shipped east and west for steam and domestic purposes.

It is an excellent "block" coal and is eagerly sought as domestic fuel.

The Marmet Coal Company Mine No. 3 (New). No. 221 on Map.

Located in Loudon district, on Lens creek, 1 mile south of Hern shaw:

	Thickness Ft.	In.			
Slate roof.					
Coal, soft	0	7			
Slate	0	½	....	3'	7½"
Coal, block; Elev. 940' A. T. B.	3	0			

Butts, N 30° W; Faces, N 60° E; Coal shipped east and west for steam and domestic coal.

The Marmet Coal Company Prospect Opening. No. 222 on Map.

Located in Loudon district, in Jim Snodgrass hollow, 1¼ miles south of Hernshaw:

	Thickness Ft.	In.			
Slate roof.					
Coal	0	6			
Slate	0	1½	....	3'	9½"
Coal, block	3	2			

Slate floor; Elev. 940' A. T. B.

Low & Butler Prospect Opening.—No. 223 on Map.

Located in Loudon district, in Grave Yard hollow on Left fork of Lens creek:

	Thickness Ft.	In.
Slate roof.		
Coal, block	3	4

Slate floor; Elev. 955' A. T. B.

Low & Butler Prospect Opening.—No. 224 on Map.

Located in Loudon district, in Bee Branch of Left fork of Lens creek:

	Thickness Ft.	In.			
Slate roof.					
Coal	0	5			
Slate	0	1½	....	3'	4"
Coal, block	2	9½			

Slate floor; Elev. 1030' A. T. B.

QUANTITY OF THACKER COAL AVAILABLE.

Very little prospecting has been done on this bed in other parts of Kanawha county, since there are other and thicker seams of coal present; however, this coal appears to be present, and occasionally proves of sufficient thickness to be of commercial value:

The writer has figured that there is about 5 square miles of available **Thacker coal** in Loudon district, and assuming that 25 cu. ft. of coal will equal a short ton, the following results are obtained:

Table Showing Approximate Available Thacker Coal.

District.	Sq. Miles.	Acres.	Thickness of Bed. Ft.	In.	Cubic Feet of Coal.	Short Tons of Coal.
Loudon	5	3,200	3	2	441,408,000	17,656,320

The following are the results of two analyses of this bed of coal in Kanawha county, giving the comparative calorific value and fuel ratio: Sample collected from Marmet Mine No. 221 on Map.

Moisture lost on Air Drying, 0.54 per cent.

AIR DRIED SAMPLE.

Proximate Analysis.

	Per Cent.
Moisture	0.67
Volatile Matter	38.94
Fixed Carbon	52.79
Ash	7.60
Total	100.00
Sulphur	3.13
Phosphorus	0.005

Ultimate Analysis.

	Per Cent.
Carbon	72.99
Hydrogen	5.08
Oxygen	9.81
Nitrogen	1.39
Sulphur	3.13
Ash	7.60
Total	100.00
Calorimeter B. T. U.	13,700
Calculated B. T. U.	13,140

SAMPLE AS RECEIVED.

Proximate Analysis.

	Per Cent.
Moisture	0.67
Volatile Matter	38.73
Fixed Carbon	52.51
Ash	7.55
Total	100.00
Sulphur	3.11
Phosphorus	0.005

Ultimate Analysis.

	Per Cent.
Carbon	72.60
Hydrogen	5.11
Oxygen	10.23
Nitrogen	1.39
Sulphur	3.11
Ash	7.60
Total	100.00
Calorimeter B. T. U.	13,630
Calculated B. T. U.	13,070

Map No. 220. Sample collected by R. W. Edmonds and called "Winifrede coal," and the analysis of which is published in Vol. II, Page 559, West Virginia Geological Survey, 1903.

Moisture	0.65
Volatile Matter	37.06
Fixed Carbon	56.70
Ash	5.59
Total	100.00
Sulphur	0.65
Phosphorus	0.015
B. T. U. (Wil. Cal.)	14,543

The Cedar Grove Coal.

The Cedar Grove coal is the next bed of economic importance in descending order in the Kanawha series. A full description of its stratigraphy, thickness and structure in Kanawha county has been given on page 280 of this report. The thickness of the prospect openings, mines and analyses will now be given by magisterial districts.

LOUDON DISTRICT.

The Cedar Grove coal is mined on a commercial basis in the southwestern part of Loudon district, along Lens creek, where it is known locally as the Lens Creek seam.

Charlmore Opening.—No. 225 on Map.

Located in Loudon district, in Ring hollow, 1.2 miles northwest of Hernshaw:

	Thickness Ft.	In.		
Slate.				
Coal	1	2		
Slate	0	1	....	3' 4"
Coal, block	2	1		

Fire clay floor; Elev. 840' A. T. B.

The coal was formerly mined here and shipped east and west for steam and domestic fuel.

The Marmet Coal Company (Mine No. 2).—No. 226 on Map.

Located in Loudon district, 1 mile south of Hernshaw:

	Thickness Ft.	In.			
Slate roof.					
Coal, block	1	1½			
Slate	0	1½			
Coal	1	6	....	3′	8½″
Slate	0	1½			
Coal, block	0	10			

Fire clay floor; Elev. 835′ A. T. B.

Low & Butler Prospect Opening.—No. 227 on Map.

Located on Mitchell fork of Lens creek, about 2 miles south of Hernshaw:

	Thickness Ft.	In.			
Slate roof.					
Coal	0	8			
Slate	0	4			
Coal	0	2			
Slate	0	2	....	3′	9½″
Coal, block	1	6			
Slate	0	1½			
Coal, block; Elev. 890′ A. T. B.	0	10			

Low & Butler Prospect Opening.—No. 228 on Map.

Located in Loudon district, in Graveyard hollow of Lens creek, 1½ miles south of Hernshaw:

	Thickness Ft.	In.			
Sandstone roof.					
Coal, hard, block	2	5			
Slate	0	1			
Coal, hard block	0	10	....	5′	8″
Fire clay	2	0			
Coal, hard, block	0	4			
Slate floor; Elev. 840′ A. T. B.					

This coal comes 346 feet underneath the Winifrede bed and 115 feet under another coal, opened in hill above.

Russell Quarrier Opening.—No. 229 on Map.

Located in Loudon district, on Fourmile fork of Lens creek, 1.3 miles west of Hernshaw:

	Thickness Ft.	In.		
Sandstone roof.				
Coal, hard, block	0	8		
Slate	0	2	.... 3'	6"
Coal, hard, block	2	8		

Fire clay floor; Elev. 900' A. T. L.

This coal was formerly mined on Fourmile fork and shipped by rail, but the mines are now abandoned.

Russell Quarrier Opening.—No. 230 on Map.

Located in Loudon district, on Mary fork of Lens creek, at the mouth of Spruce fork:

	Thickness Ft.	In.		
Slate roof.				
Coal, gas	1	4	.... 3'	0"
Coal, hard, block	1	8		

Fire clay floor; Elev. 810' A. T. B.

The coal has been mined for local use.

MALDEN DISTRICT.

The Cedar Grove coal is mined at Belle station, near the mouth of Simmons creek by the Campiatt Coal Company, where the following section was measured:

Campiatt Coal Company Mine.—No. 231 on Map.

Located in Malden district at Belle P. O.:

	Thickness Ft.	In.		
Sandstone roof.				
Coal, soft	0	10		
Bone	0	4	.... 3'	10"
Coal, block	2	8		

Slate floor; Elev. 910' A. T. B.

The coal is shipped east and west for steam and domestic purposes. This bed comes 405 feet below the Kanawha Black Flint.

CABIN CREEK DISTRICT.

The Cedar Grove coal is mined on a commercial scale on the north side of the Kanawha river, near Cedar Grove.

The Marmet Coal Company (Monarch Mine.) No. 232 on Map.

Located in Cabin Creek district, at Monarch P. O.:

	Thickness Ft.	In.			
Slate, grayish.					
Coal, hard	0	4			
Slate, gray	0	10	....	4'	2"
Coal, gas	0	9			
Coal, block, hard	2	3			

Fire clay floor; Elev. 695' A. T. B.

The coal is shipped east and west for steam and domestic fuel.

New Cedar Grove Colliery Co. Mine.—No. 233 on Map.

Located in Cabin Creek district near Cedar Grove.

	Thickness Ft.	In.			
Sandstone.					
Coal	0	3			
Coal, gray fossiliferous	0	3	....	3'	8"
Coal, medium hard	1	4			
Coal, hard, block	1	10			

Fire clay floor; Elev. 725' A. T. B.

This mine is now abandoned.

Sunday Creek Company (Mine No. 110).—No. 234 on Map.

Located in Cabin Creek district near Cedar Grove.

	Thickness Ft.	In.			
Sandstone.					
Slate	5	0			
Coal, hard	0	4			
Slate, fossiliferous (plants)	1	3	....	4'	3"
Coal, hard, block	2	8			

Fire clay floor; Elev. 765' A. T. B.

The coal is shipped east and west for steam and domestic purposes.

Sunday Creek Coal Company Mine.—No. 235 on Map.

Located in Cabin Creek district, on Kelly creek, near Cedar Grove:

	Thickness Ft.	In.
Gray shales		
Coal, hard, block	2	10

Fire clay floor; Elev. 775′ A. T. B.

This coal was formerly operated here, but the mine is now abandoned.

Sunday Creek Coal Company Opening.—No. 236 on Map.

Located in Cabin Creek district on Frozen Branch of Kelly creek, 1¼ miles northwest of Cedar Grove.

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Slate, bluish	8	0		
Coal, gas	1	2		
Bone	0	2		
Coal	0	10	....	5′ 1″
Bone	0	5		
Coal, gray splint	2	6		

Fire clay floor; Elev. 780′ A. T. B.

This opening is 440 feet below the **Kanawha Black Flint,** which crops in hill immediately above, at 130 feet above the **Coalburg coal.**

Sunday Creek Coal Company Opening.—No. 237 on Map.

Located in Cabin Creek district on Bufflick Branch of Kelly creek:

	Thickness Ft.	In.		
Sandstone	..	..		
Slate, gray	0	11		
Coal, gas	0	3		
Fire clay and gray slate	0	6		
Coal, gas	0	10	...	3′ 5″
Coal, hard, block	1	10		

Fire clay floor; Elev. 730′ A. T. B.

The coal is mined for local fuel at this point.

Sunday Creek Coal Company Opening.—No. 238 on Map.

Located in Cabin Creek district, on Left Fork of Witchers creek:

	Thickness Ft.	In.			
Sandstone, massive	..	..			
Slate	8	0			
Coal	0	3			
Slate, gray	0	1			
Coal, hard, block	1	11	....	3′	1″
Slate, gray	0	2			
Coal; Elev. 800′ A. T. B.	0	8			

The coal is mined for local use.

Kelly Creek Colliery Company, Mine No. 4. No. 238(A) on Map.

Located in Cabin Creek district, on Kelly creek at Ward P. O.

	Thickness Ft.	In.
Slate roof	..	..
Coal, block	3	0
Fire clay floor	..	..

The coal was formerly mined here and shipped west for steam and domestic fuel.

Riverside Coal Opening.—No. 239 on Map.

Located in Cabin Creek district at Riverside P. O.:

	Thickness Ft.	In.			
Sandstone, massive.					
Slate	3	0			
Coal, block	0	6			
Slate, gray (fossiliferous plants)	3	0	....	6′	6″
Coal, gas	1	0			
Coal, block	2	0			

Fire clay floor; Elev. 760′ A. T. B.

The bed was formerly mined here on a commercial basis, but the mines are now abandoned.

The Cedar Grove coal was once mined at Crown Hill, where the following section was measured:

Crown Hill Opening.—No. 240 on Map.

Located in Cabin Creek district at Crown Hill:

	Thickness Ft.	In.
Slate top.		
Coal, hard, block; Elev. 725' A. T. B.....	2	8

The mine is abandoned.

East Bank Mining Company Mine.—No. 241 on Map.

Located in Cabin Creek district at Eastbank:

	Thickness Ft.	In.	
Slate roof.			
Coal,gas.....	0	10	
Coal, medium hard.....	0	11	.... 2' 10"
Coal, very hard; Elev. 735' A. T. B.....	1	1	

Coalburg-Kanawha Coal Company Mine.—No. 242 on Map.

Located in Cabin Creek district at Coalburg:

	Thickness Ft.	In.
Slate roof.		
Coal, hard, block.....	2	8
Slate floor.		

The coal was formerly mined here by the Robinson Coal Company, but is now owned by the Coalburg-Kanawha Coal Company.

Dry Branch Coal Company Prospect Opening. No. 242(A) on Map.

Located in Cabin Creek district, on Cabin creek at Dry Branch P. O.:

	Thickness Ft.	In.
Slate roof		
Coal, hard block.....	2	8
Fire clay floor. Elev. 760' A. T. B.		

Slaughter Creek Coal & Land Company.—No. 243 on Map.

Located in Cabin Creek district on Bradly fork of Slaughter creek:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, block, hard	2	4

Fire clay floor. Elev. 770' A. T. B.

The coal is mined here for local use.

Persinger Coal Company Mine.—No. 244 on Map.

Located in Cabin Creek district at Miami:

	Thickness Ft.	In.			
Slate top	..	..			
Coal	0	10			
Slate	0	2			
Coal, hard, block	2	5	....	4'	0"
Slate	0	1			
Coal	0	6			

Slate floor. Elev. 770' A. T. B.

The coal was formerly mined here, but the mines are now abandoned.

William Foster Opening.—No. 245 on Map.

Located in Cabin Creek district on Coal Fork of Cabin Creek, 1.3 miles west of Eskdale P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal	0	10			
Slate	0	2			
Coal, hard, block	2	4	....	3'	11"
Slate	0	1			
Coal	0	6			

Slate floor. Elev. 945' A. T. B.

The coal is mined here for local use.

National Bituminous Coal & Coke Co. Prospect Opening. No. 246 on Map.

Located in Cabin Creek district, one-half mile southwest of Eskdale:

	Thickness Ft.	In.		
Slate roof	..	..		
Coal	0	6		
Slate	0	2½	....	4' 7"
Coal, hard, block. Elev. 1015' A. T. B.	3	10½		

National Bituminous Coal & Coke Company Prospect Opening.—No. 247 on Map.

Located in Cabin Creek district at Eskdale:

	Thickness Ft.	In.		
Slate roof	..	..		
Coal	0	8		
Slate	0	6	....	4' 2"
Coal, hard, block. Elev. 1010' A. T. B...	3	0		

Cabin Creek Consolidated Coal Company Opening. No. 248 on Map.

Located in Cabin Creek district, on north end of Seng Creek tunnel of Chesapeake & Ohio Ry., one mile southeast of Kayford:

	Thickness Ft.	In.		
Slate roof	..	..		
Coal, block	2	0		
Slate	1	0	....	3' 7"
Coal	0	7		

Fire clay floor. Elev. 1610' A. T. B.

The coal was mined for engine and power house use while the tunnel was being constructed.

Carbon Coal Company Prospect Opening.—No. 249 on Map.

Located in Cabin Creek district at Nabob:

	Thickness Ft.	In.
Slate roof	..	..
Coal	2	1

Slate floor. Elev. 1475' A. T. B.

The foregoing sections give the general structure and thickness of the **Cedar Grove bed** in Kanawha county.

Available Coal Tonnage in Cedar Grove Bed.

It is rather difficult to arrive at an approximate available coal tonnage for this bed in Kanawha county. While the coal is fairly persistent throughout the southeastern portion of Kanawha, yet the bed is thin and very little prospecting has been done to ascertain its extent, where the thicker beds exist.

The writer has assumed the following areas and thickness, given in the table by magisterial districts, and figured on the basis of 25 cubic feet to the short ton, as with the Pittsburgh coal on a previous page:

Table Showing Approximate Available Cedar Grove Coal.

Districts.	Sq. Miles.	Acres.	Thickness of Bed. Ft.	Thickness of Bed. In.	Cubic Feet of Coal.	Short Tons of Coal.
Cabin Creek...	100	64,000	3	0	8,363,520,000	334,540,800
Loudon	18	11,520	3	0	1,505,433,600	60,217,344
Malden	4	2,520	3	0	329,313,600	13,172,544
Totals....	122	78,040			10,198,267,200	407,930,688

The following table gives the comparative calorific value and fuel ratio of the coal in the **Cedar Grove bed** in Kanawha county:

Analyses of Cedar Grove Coal in Kanawha County.

(Under the heading "Condition of Sample", "A. D."=air dried; and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
226	Marmet Coal Co., Mine No. 2	Loudon	A.D.	1.06	37.59	57.66	0.001	3.69	0.74	77.01	5.56	11.69	1.31	14220	13770	5.01
226	Marmet Coal Co., Mine No. 2	Loudon	A.R.	1.06	37.59	57.66	0.001	3.69	0.74	77.01	5.56	11.69	1.31	14220	13770	5.01
231	Campiatt Coal Co.	Malden	A.R.	1.06	39.28	53.77	0.005	5.89	0.74	76.87	5.12	10.09	1.29	14060	14180	4.81
231	Campiatt Coal Co., Lower Strata	Malden	A.R.	0.71	46.90	38.73	0.006	13.66	1.32	69.74	5.63	8.33	1.32	13580	13040	3.17
232	Marmet Coal Co., Monarch Mine	Cabin Creek	A.D.	1.30	34.22	59.64	0.004	4.84	1.06	77.18	5.67	10.50	1.16	14411	13751	5.03
*232	Marmet Coal Co., Monarch Mine	Cabin Creek	A.D.	0.85	37.90	56.56	0.019	4.69	0.62	79.70	5.43	8.01	1.55	14450	14370	6.27
x232	Marmet Coal Co., Monarch Mine	Cabin Creek	A.R.	1.06	37.82	56.44	0.019	4.68	0.62	79.53	5.44	8.18	1.55	14420	14340	6.18
233	New Cedar Grove Colliery Co.	Cabin Creek	A.D.	0.98	35.97	58.89	0.003	4.16	0.73	78.89	5.00	10.26	1.24	14353	13793	5.47
234	Sunday Creek Company, Mine No. 110	Cabin Creek	A.D.	0.88	35.62	59.22	0.002	4.28	0.67	79.34	4.99	9.72	1.27	14131	13884	5.67
235	Sunday Creek Company	Cabin Creek		0.79	36.04	58.92	0.003	4.25	0.46	....	....	....	....	.....	14767	.....
*241	East Bank Mining Co.	Cabin Creek	A.D.	0.74	37.60	56.66	0.004	5.00	1.02	79.10	5.39	7.92	1.57	14340	14280	6.12
x241	East Bank Mining Co.	Cabin Creek	A.R.	1.04	37.49	56.49	0.004	4.98	1.02	78.86	5.40	8.17	1.57	14300	14240	6.00
240	———— Crown Hill	Cabin Creek		1.07	35.96	57.07	0.004	5.90	0.74	....	....	....	....	.....	14535	.....
241	East Bank Mining Co.	Cabin Creek		0.76	37.37	57.41	0.006	4.46	0.66	....	....	....	....	.....	14649	.....
242	Coalburg-Kanawha Coal Co.	Cabin Creek		1.27	35.66	55.95	0.007	7.12	0.81	....	....	....	....	.....	14071	.....
242A	Dry Branch Coal Co.	Cabin Creek	A.D.	0.95	35.30	54.97	0.004	8.78	1.68	75.05	4.85	9.31	0.96	13839	13312	4.15
239	———— Riverside Coal Opening	Cabin Creek	A.D.	1.12	35.63	58.25	0.001	5.00	0.59	79.99	5.00	8.34	1.32	14353	14114	6.00

*Collected by D. D. Teets, Jr.
xCorrected for Moisture.

Page Reference to Detailed Description and Sections of Coal Openings and Mines Listed in Preceding Table.
Cedar Grove Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
226	371	Marmet Coal Co., Mine No. 2.....	517
231	342	Campiatt Coal Co.	518
232	Bull. II, p. 285, No. 20	Marmet Coal Co., Monarch	519
233	Bull. II, p. 285, No. 21	New Cedar Grove Colliery Co	519
234	Bull. II, p. 285, No. 22	Sunday Creek Co., Mine No. 110.....	519
235	Vol. II, p. 563	Sunday Creek Company	520
240	Vol. II, p. 565	Crown Hill	522
*241	365	East Bank Mining Company	522
241	Vol. II, p. 565	East Bank Mining Company	522
242	Vol. II, p. 565	Coalburg Kanawha Coal Co.	522
242A	Bull. II, p. 285, No. 24	Dry Branch Coal Co.	522
239	Bull. II, p. 285, No. 23	Riverside Coal Opening	521

*Collected by D. D. Teets, Jr.

The Peerless Coal

The Peerless coal is the next bed of economic importance in descending order. The description of its stratigraphy, structure and character has been given on pages 281 and 282 of this report. The thickness and analyses of this bed will now be taken up by magisterial districts.

MALDEN DISTRICT.

J. B. Lewis Opening.—No. 250 on Map.

Located in Malden district on the Right Fork of Coal Fork of Campbell Creek:

	Thickness Ft.	In.		
Sandstone roof	..	..		
Coal, hard block	1	1		
Slate and fire clay	1	4	....	3' 8"
Coal, hard, block	1	3		

Fire clay floor. Elev. 725' A. T. B.

J. B. Lewis Opening.—No. 251 on Map.

Located in Malden district on Coal Fork of Campbell Creek, one mile southeast of Coal Fork P. O.:

	Thickness Ft.	In.		
Sandstone roof	..	..		
Coal, hard, block	1	2		
Slate	1	1	....	3' 6"
Coal, hard, block. Elev. 740' A. T. B....	1	3		

The foregoing section represents the character and structure of the Peerless coal in Malden district.

CABIN CREEK DISTRICT.

Peerless Coal Company Mine.—No. 252 on Map.

Located in Cabin Creek district at Lewiston P. O.:

	Thickness Ft.	In.
Slate roof	..	..
Coal, gas	2	8

Slate floor. Elev. 645' A. T. B.

The coal was once mined here for steam and domestic purposes, but the mine is now abandoned.

Winifrede Coal Company (Arbuckle Mine). No. 253 on Map.

Located in Cabin Creek district on Fields Creek southeast of Lewiston P. O.:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, gas	2	8

Fire clay floor. Elev. 740' A. T. B.

The coal was once mined here on a commercial scale, but the mine is now abandoned.

Winifrede Coal Company Opening.—No. 254 on Map.

Located in Cabin Creek district on Sugarcamp Branch of Fields Creek, 1.7 miles southwest of Lewiston P. O.:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, gas	2	3

Fire clay floor. Elev. 715' A. T. B.
Prospect opening.

Mrs. Bradford Opening.—No. 255 on Map.

Located in Cabin Creek district on Fields Creek at mouth of Scott Branch:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, gas	2	4

Fire clay floor Elev. 680' A. T. B.

The coal is mined for local use.

Julian Johnson Opening.—No. 256 on Map.

Located in Cabin Creek district on Fields Creek, one mile north of Winifrede P. O.:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, gas	2	6

Fire clay floor. Elev. 725' A. T. B.

The coal is mined for local use.

Slaughter Creek Coal & Land Company Opening. No. 257 on Map.

Located on Slaughter Creek, one mile south of Chelyan P. O.:

	Thickness Ft.	In.		
Sandstone, massive	..	..		
Shale	2	0		
Coal	0	1		
Slaty shale	0	5		
Coal	0	8	....	5' 11"
Slaty shale	2	5		
Coal, gas, good	2	4		

Fire clay floor. Elev. 650' A. T. B.

The coal is mined for local use.

Witchers Creek Coal Company Opening.—No. 258 on Map.

Located in Cabin Creek district, on north side of Kanawha River, just below mouth of Witchers Creek:

	Thickness Ft.	In.
Sandstone	..	..
Coal, good	3	2

Fire clay floor. Elev. 700' A. T. B.

The coal was formerly mined here and shipped by rail, but the mine is now abandoned.

Lewis Coal & Coke Company Mine No. 1.—No. 259 on Map.

Located in Cabin Creek district at Cabin Creek Junction.

	Thickness Ft.	In.
Slate roof	..	..
Coal, gas	2	4

Fire clay floor. Elev. 675' A. T. B.

Butts, N. 15° W.; faces, N. 75° E.

The coal is mined for steam and domestic use. The company is furnishing fuel for the locomotives of the Chesapeake and Ohio Ry.

Pine Grove Coal Company Opening.—No. 260 on Map.

Located in Cabin Creek district on Cabin Creek, one-half mile south of Cabin Creek Junction:

	Thickness Ft.	In.		
Sandstone	..	..		
Slate	3	0		
Coal	2	10		
Slate	0	2½	.... 3'	7"
Coal. Elev. 695' A. T. B.	0	6½		

Butts, N. 15° W.; faces, N. 75° E.

The coal was formerly mined on a commercial scale, but is now abandoned.

Dry Branch Coal Company Mine.—No. 261 on Map.

Located in Cabin Creek district at Dry Branch:

	Thickness Ft.	In.
Sandstone roof	..	..
Coal, gas	3	0

Fire clay floor. Elev. 695' A. T. B.

The coal was once mined here on a commercial scale, but the mine is now abandoned.

The Peerless coal has been mined at Ronda on Cabin creek, by the Coalburg Colliery Company, where it is 3 feet thick at an elevation of 687' A. T. L.

The Peerless coal appears in the railroad grade in several places on Cabin creek and is usually from 2 feet to 2 feet 4 inches thick.

West Virginia Coal Company Prospect Opening. No. 262 on Map.

Located in Cabin Creek district on Gibson Branch, two miles south of Wevaco:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, hard, block	0	4			
Slate	0	0½			
Coal, hard	0	6	....	1'	9½"
Slate	0	1			
Coal	0	10			

Elev. 1565' A. T. B.

From the foregoing openings, it appears that the **Peerless coal** is a thin bed and cannot be mined in competition with the thicker seams at present, but will be of commercial value in the future when the thicker beds have been exhausted. Its purity (being low in ash and sulphur) will enhance its value in the future as a gas producer, and possibly as a coking coal.

QUANTITY OF PEERLESS COAL AVAILABLE.

In estimating the available tonnage of this coal, the writer feels safe in assuming an average thickness of 2 feet and 3

inches spread over the area in the magisterial districts given in the accompanying table, and figured on the basis of 25 cubic feet of coal to the short ton, the following results are obtained:

Table Showing Approximate Available Peerless Coal.

Districts.	Sq. Miles.	Acres.	Thickness of Bed. Ft.	Thickness of Bed. In.	Cubic Feet of Coal.	Short Tons of Coal.
Cabin Creek	150	96,000	2	3	9,408,960,000	376,358,400
Loudon	20	12,800	2	5	1,254,528,000	50,181,120
Malden	15	9,600	2	3	940,896,000	37,635,840
Totals	185	118,400			11,604,384,000	464,175,360

The following table gives the composition, calorific value and fuel ratio of the Peerless coal in Kanawha county:

Analyses of Peerless Coal in Kanawha County.

(Under the heading "Condition of Sample": "A. D."=Air dried, and "A. R."=As received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
252	Peerless Coal Co.	Cabin Creek		0.62	37.33	58.41	0.003	3.64	0.83	.....	.....	.....	.....	14768	.....	.....
253	Winifrede Coal Co., Arbuckle Mine	Cabin Creek		1.07	38.69	57.25	0.0025	2.99	1.25	.....	.....	.....	.....	14641	.....	.....
255	Mrs. Bradford	Cabin Creek	A.R.	1.06	43.92	47.23	0.007	7.79	2.43	.....	.....	.....	.....	.....	.....	.....
257	Slaughter Creek Coal & Land Co.	Cabin Creek	A.R.	0.90	34.28	59.84	0.007	4.98	0.51	.....	.....	.....	.....	.....	.....	.....
259	Lewis Coal & Coke Co.	Cabin Creek	A.R.	0.83	38.73	57.27	0.003	3.17	0.67	79.87	5.41	9.60	1.28	14450	14260	6.25
259	Lewis Coal & Coke Co.	Cabin Creek	A.D.	0.83	38.73	57.27	0.003	3.17	0.67	79.87	5.41	9.60	1.28	14450	14260	6.25
260	Pine Grove Coal Co. (Abandoned)			0.59	35.76	58.87	0.002	4.78	1.05	.....	.....	.....	.....	.....	.....	.....
Average				0.84	38.21	56.59	0.004	4.36	1.06	79.87	5.41	9.60	1.28	14577	14260	5.72

Page Reference to Detailed Description and Sections of Coal Openings and Mines Listed in Preceding Table.

Peerless Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
252	Bull. II, p. 276, No. 4	Peerless Coal Company	528
253	Bull. II, p. 276, No. 5	Winifrede Coal Company, Arbuckle Mine.	528
255	351	Mrs. Bradford	529
257	359	Slaughter Creek Coal & Land Co.	529
259	368	Lewis Coal & Coke Co., Mine No. 1	530
260	Bull. II, p. 276, No. 6	Pine Grove Coal Co.	530

The No. 2 Gas Coal.

The No. 2 Gas coal is the next in descending order and is one of the most important coals in the Kanawha series, containing the greatest amount of available coal of any bed in Kanawha county.

LOUDON DISTRICT.

This bed was early mined at Malden, on the south side of the Kanawha river, where the coal was used for fuel in the manufacture of salt. One mine at Malden has long been abandoned and later the coal was mined by the Black Band Coal & Coke Company at Carkin.

Black Band Coal & Coke Company (Carkin Mine). No. 263 on Map.

Located in Loudon district at Carkin:

	Thickness Ft.	In.		
Sandstone	..	..		
Slate	0	4		
Coal	0	6	....	3' 6"
Bone	0	2		
Coal	2	6		

Fire clay floor. Elev. 690' A. T. B.
Butts, N. 60° W.; faces, N. 30° E.

The coal was formerly mined on a commercial scale and shipped east and west for steam and domestic purposes. The coal is now mined for local use by farmers living near. The seam appears variable, as is shown in the following sections measured at another point in the mine:

	Thickness Ft.	In.			
Sandstone	..	..			
Coal, block	3	0			
Slate	0	8	....	3′	10″
Coal	0	2			

Slate floor. Elev. 690′ A. T. B.

The Marmet Coal Company (Butler).—No. 264 on Map.

Located in Loudon district at Hernshaw:

	Thickness Ft.	In.			
Sandstone	..	..			
Coal	0	1			
Slate	0	2			
Coal, hard, splint	3	4	....	5′	11″
Slate	0	4			
Coal, gas	2	0			

Slate floor. Elev. 750′ A. T. B.

Butts, N. 30° W.; faces, N. 60° E.

The Marmet Coal Company (New Butler).—No. 265 on Map.

Located in Loudon district, one-half mile south of Hernshaw:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, gas	0	9			
Bone	0	2	....	3′	11″
Coal, gas	1	2			
Coal, hard, block	1	10			

Fire clay floor. Elev. 735′ A. T. L.

Butts, N. 30° W.; faces, N. 60° E.

The coal is shipped east and west for steam and domestic purposes.

The Marmet Coal Company Opening.—No. 266 on Map.

Located in Loudon district, on Left Fork of Lens Creek, one-half mile from mouth of Left Fork:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal	0	10	}		
Bone	0	2	}	2'	6"
Coal, hard block	1	6	}		

Fire clay floor. Elev. 755' A. T. L.

MALDEN DISTRICT.

The No. 2 Gas coal was early mined near the mouth of Campbell creek, where it was locally named the Campbell Creek coal, and owing to its purity and excellent quality as a domestic coal, it was early in demand for steam and domestic fuel.

Campbells Creek Coal Company (Calderwood Mine). No. 267 on Map.

Located in Malden district at Dana:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	0	2			
Coal	2	3	}		
Black slate	0	4	}		
Coal	0	11	}		
Slate	0	1	}	7'	0½"
Coal	0	11½	}		
Slate	1	1	}		
Coal. Elev. 610' A. T. B.	1	5	}		

Butts, S. 85° W.; faces, S. 5° E.

The coal was formerly mined on a commercial basis, but the mine is now abandoned.

Campbells Creek Coal Company (Spring Fork Mine). No. 268 on Map.

Located in Malden district, one mile northeast of Dana P. O.:

	Thickness Ft.	In.			
Sandstone	..	..			
Slate	0	3			
Coal, hard, block	2	2			
Slate	0	1			
Coal	2	7	....	6′	0″
Slate	1	0			
Coal, visible. Elev. 600′ A. T. B.	0	2			

Virginia Coal Company Mine.—No. 269 on Map.

Located in Malden district at Coal Fork P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, hard, splint	1	2			
Coal, gas	2	0	....	3′	4″
Bone	0	2			

Slate floor. Elev. 620′ A. T. B.

Butts, N. 85° W.; faces, S. 5° E.

The coal is shipped east and west for steam and domestic purposes.

Plus Levi Coal Opening.—No. 270 on Map.

Located in Malden district at Levi P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, hard, splint	1	4			
Slate	0	1			
Coal, hard, block	2	6	....	4′	11″
Slate	0	6			
Coal, impure	0	6			

Slate floor. Elev. 705′ A. T. B.

The coal is being mined for local use.

CABIN CREEK DISTRICT.

Cedar Grove Coal Company (Mine No. 2).—No. 271 on Map.

Located in Cabin Creek district at Cedar Grove:

	Thickness Ft.	In.
Slate roof	..	..
Coal	3	2

Slate floor. Elev. 625' A. T. B.

The coal was formerly mined on a commercial scale at this point, but the mine is now abandoned.

Hughes Creek Coal Company (Mine No. 4).—No. 272 on Map.

Located in Cabin Creek district, one-half mile northeast of Hugheston:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, gas	2	2			
Slate	0	0½			
Coal	1	1½	....	3'	9"
Slate	0	1			
Coal	0	4			

Slate floor. Elev. 720' A. T. B.

Butts, N. 50° E.; faces, N. 40° W.

Coal shipped east and west for steam and domestic purposes.

Huntington Est. Opening.—No. 273 on Map.

Located in Cabin Creek district, in Custer Hollow, one-half mile northeast of Loudon:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, gas	3	4			
Slate	0	2	....	3'	10"
Coal. Elev. 715' A. T. B.	0	4			

The coal is mined for local use by tenants.

Huntington Estate Opening.—No. 274 on Map.

Located in Cabin Creek district, on Slater Branch of Kanawha River, one mile northwest of Montgomery:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, block	2	0			
Slate	0	8			
Coal, gas	0	6	....	6′	6″
Slate	0	2			
Coal, gas. Elev. 680′ A. T. B.	3	2			

The coal is mined for local use by J. E. Gladwell.

Cannelton Coal Company Prospect Opening.—No. 275 on Map.

Located in Cabin Creek district, on Staten Run, one-half mile north of Montgomery:

	Thickness Ft.	In.
Slate roof	..	..
Coal, visible. Elev. 720′ A. T. B.	4	0

Cannelton Coal Company Mine No. 2.—No. 276 on Map.

Located in Cabin Creek district, 1½ mile northeast of Cannelton:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal hard	2	0	....	5′	5″
Coal, gas	3	5			

Fire clay floor. Elev. 720′ A. T. B.

The coal is shipped east and west for steam, domestic, coking, and by-product purposes.

Eureka Coal Company (Mine No. 1).—No. 277 on Map.

Located in Cabin Creek district at Donwood P. O.:

	Thickness Ft.	In.			
Slate roof	..	..			
Coal, good	3	0			
Slate	0	8			
Coal, hard	2	2	....	9′	8″
Slate	0	10			
Coal, gas. Elev. 805′ A. T. B.	3	0			

The coal is shipped east and west for steam, domestic, coking, and by-product purposes.

Champ and Carter Mine.—No. 278 on Map.

Located in Cabin Creek district, one mile west of Montgomery on C. & O. Ry.:

	Thickness Ft.	In.			
Slaty roof	..	..			
Coal, splint	2	6			
Slate	1	6	....	7'	6"
Coal, gas	3	6			

Fire clay floor. Elev. 710' A. T. B.

The coal is shipped east and west for steam, domestic, coking, and by-product purposes.

Chesapeake Mining Company (Mine No. 2).—No. 279 on Map.

Located in Cabin Creek district, on Upper Creek of Kanawha River, one-half mile south of Handley:

	Thickness Ft.	In.			
Sandy shale	..	..			
Coal, soft, "rider"	0	6			
Hard, sandy shales	4	0			
Coal, splint	0	5			
Coal, soft	1	8			
Slate, gray	0	1	....	4'	5½"
Coal, soft	0	2½			
Slate, gray	0	7			
Coal, semi-splint	1	4			

Fire clay floor. Elev. 680' A. T. B.

Lackawanna Coal & Lumber Company (Nuckolls Mine). No. 280 on Map.

Located in Cabin Creek district on Paint Creek at Nuckolls:

	Ft.	In.			
Sandstone roof	..	..			
Coal, soft	2	9			
Slate, block	0	5½			
Coal, soft	1	0½	....	4'	8½"
Bone	0	0½			
Coal, soft	0	5			

Slate floor. Elev. 1330' A. T. B.

Butts, N. 80° E.; faces, N. 10° W.

Coal shipped east for steam and general purposes.

Lackawanna Coal & Lumber Co. (Greenbrier Mine No. 2). No. 281 on Map.

Located in Cabin Creek district, on Paint creek, ½ mile south of Tomsburg:

	Thickness Ft.	In.			
Sandstone.					
Coal, soft, some sulphur bands	3	10	....	4'	6"
Slate, block	0	1½			
Coal, soft	0	6½			

Fire clay floor; Elev. 1360' A. T. B.

Butts, N. 55° E.; faces, N. 35° W.

Coal shipped east and west for general fuel purposes.

National Bituminous Coal & Coke Co. (Mine No. 2). No. 282 on Map.

Located in Cabin Creek district, on Cabin creek, ½ mile south of Eskdale:

	Thickness Ft.	In.			
Slate roof.					
Coal, hard	2	0	....	4'	8"
Coal, gas	2	8			

Fire clay floor; Elev. 860' A. T. B.

Butts, East; faces, north.

Coal shipped east and west for steam and general fuel purposes.

Southern Colliery Company (Mine No. 2).—No. 283 on Map.

Located in Cabin Creek district, on Cain Fork of Cabin creek:

	Thickness Ft.	In.
Slate roof.		
Coal, gas	3	10

Slate floor; Elev. 1020' A. T. B.

Butts, North; Faces, East.

This coal was formerly mined here on a commercial scale, but is now abandoned.

Cabin Creek Consolidated Coal Co. (Holly Mine). No. 284 on Map.

Located in Cabin Creek district, on Cabin creek, ½ mile east of Leewood:

	Thickness Ft.	In.		
Slate roof.				
Coal, hard, splint	0	4		
Coal, soft	3	6	.... 5'	0"
Coal, hard	0	4		
Coal, soft	0	10		
Slate floor.				

The coal is shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Quarrier Mine). No. 285 on Map.

Located in Cabin Creek district, on Cabin Creek, 1½ miles southeast of Leewood:

	Thickness Ft.	In.
Slate roof.		
Coal, gas	4	8
Slate floor; Elev. 1306' A. T. L.		

Butts, North; Faces, East.

Coal is shipped east and west for general fuel purposes.

Wake Forest Mining Company Mine.—No. 286 on Map.

Located in Cabin Creek district, on Cabin creek at Wake Forest:

	Thickness Ft.	In.		
Slate roof.				
Coal, gas	3	4		
Coal, hard	0	6	.... 5'	7"
Coal, soft	1	9		
Slate floor; Elev 1345' A. T. B.				

Butts, N. 63° E.; Faces, N. 27° W.

Coal shipped east and west for steam and general fuel purposes.

Carbon Coal Company (North Carbon Mine). No. 287 on Map.

Located in Cabin Creek district, 1 mile north of Decota:

	Thickness Ft.	In.			
Slate roof.					
Coal, medium hard	1	5			
Coal, soft	1	6			
Slate, gray	0	2	....	6′	0″
Coal, soft	2	0			
Coal, hard	0	2			
Coal, soft; Elev. 1320′ A. T. B.	0	9			

Butts, N. 78° E.; faces, N. 12° W.

Coal shipped east and west for steam and general fuel purposes.

Wyatt Coal Company (Berlin Mine).—No. 288 on Map.

Located in Cabin Creek district, at Laing, 1.2 miles north of Decota:

	Thickness Ft.	In.
Slate roof.		
Coal with some sulphur balls, gas	5	9

Slate floor; Elev. 1310′ A. T. B.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Bellclare Mine). No. 289 on Map.

Located in Cabin Creek district, ¼ mile east of Decota:

	Thickness Ft.	In.			
Sandstone.					
Slate	2	0			
Coal	2	5			
Slate	0	6	....	5′	8″
Coal	2	9			

Slate floor; Elev. 1422′ A. T. L.

Butts, N. 40° E.; faces, N. 50° W.

Coal shipped east and west for steam and general fuel purposes.

Carbon Coal Co. (South Carbon Mine).—No. 290 on Map.

Located in Cabin Creek district, on Cabin creek, at Carbon:

	Thickness Ft.	In.			
Sandstone.					
Coal, gas	4	4	}		
Coal, hard	0	8	}	5′	9″
Coal, soft	0	9	}		

Slate floor; Elev. 1425′ A. T. B.

Butts, N. 78° E.; faces, N. 12° W.

Coal shipped east and west for steam and general fuel purposes.

Republic Coal Company (Mine No. 1).—No. 291 on Map.

Located in Cabin Creek district, on left side of Cabin creek at Republic, 1 mile southeast of Decota:

	Thickness Ft.	In.			
Sandstone.					
Slate	5	0			
Coal, medium hard	1	3	}		
Coal, soft	3	8	}	6′	4″
Coal, hard	0	2	}		
Coal, soft; Elev. 1590′ A. T. B.	1	3	}		

Butts, N. 50° W.; faces, N. 40° E.

Coal is shipped east and west for steam and general fuel purposes.

Republic Coal Co. (Mine No. 2).—No. 292 on Map.

Located in Cabin Creek district, just west of Mine No. 1:

	Thickness Ft.	In.			
Slate roof.					
Coal	2	7	}		
Slate	0	2	}	5′	0″
Coal	2	3	}		

Slate floor; Elev. 1600′ A. T. B.

Butts, N. 50° W.; faces, N. 40° E.

Coal shipped east and west for steam and general fuel purposes.

PLATE XXVII.—Scene on Cabin Creek at South Carbon mine showing No. 2 Gas coal mine.

VIA RAIL CANADA

Republic Coal Company (Mine No. 3).—No. 293 on Map.

Located in Cabin Creek district, on east side of Cabin creek, 2½ miles southeast of Carbon:

	Thickness Ft.	In.			
Sandstone roof	..	..			
Coal, gas	3	2			
Bone	0	1	....	4′	2″
Coal	0	11			

Fire clay floor; Elev. 1770′ A. T. B.

Butts, N. 50° W.; faces, N. 40° E.

Coal shipped east and west for steam and general fuel purposes.

Republic Coal Co. (Mine No. 4).—No. 294 on Map.

Located in Cabin Creek district, on west bank of Cabin creek, 2½ miles southeast of Carbon:

	Thickness Ft.	In.			
Slate roof.					
Coal, gas	3	0			
Bone	0	1	....	4′	0″
Coal	0	11			

Fire clay floor; Elev. 1780′ A. T. B. Butts, N. 60° W.; faces, N. 40° W.

Coal shipped east and west for steam and general fuel purposes.

West Virginia Colliery Company (Mine No. 1). No. 295 on Map.

Located in Cabin Creek district, on Fifteen Mile fork of Cabin creek, 1.2 miles south of Decota:

	Thickness Ft.	In.			
Slate, roof.					
Coal	2	5			
Slate	4	24	....	6′	4″
Coal	2	9			

Slate floor; Elev. 1435′ A. T. B.

Butts, N. 50° W.; faces, N. 40° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (United Mine). No. 296 on Map.

Located in Cabin Creek district, on Fifteen Mile fork of Cabin creek, near Wevaco P. O.:

	Thickness Ft.	In.			
Slate roof.					
Coal, medium hard	1	4			
Coal, soft	2	3			
Coal, gray	0	4	....	5′	6″
Slate	0	4			
Coal, soft	1	3			

Slate floor. Elev. 1448′ A. T. B.

Butts, N. 36° W.; faces, N. 54° E.

Coal shipped east and west for steam and general fuel purposes.

West Virginia Colliery Co. (Mine No. 2).—No. 297 on Map.

Located in Cabin Creek district, on Fifteen Mile fork of Cabin creek, one mile south of Wevaco:

	Thickness Ft.	In.			
Slate roof.					
Coal, gas	2	7			
Slate	0	1	....	4′	9″
Coal, gas	2	1			

Slate floor; Elev. 1490′ A. T. B.

Butts, N. 36° W.; faces, N. 54° E.

Coal shipped east and west for steam and general fuel purposes.

West Virginia Colliery Co. (Mine No. 4).—No. 298 on Map.

Located in Cabin Creek district, on Long Branch of Fifteen Mile Fork of Cabin creek:

	Thickness Ft.	In.			
Slate roof.					
Coal, gas	2	7			
Bone	0	2	....	5′	4″
Coal, gas	2	7			

Slate floor; Elev. 1575′ A. T. B.

Butts, N. 36° W.; faces, N. 54° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Cherokee Mine). No. 299 on Map.

Located in Cabin Creek district, on Cabin creek, at Leewood:

	Thickness Ft.	In.
Slate roof.		
Coal, gas	4	10

Slate floor; Elev. 1025' A. T. B.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Caledonia Mine). No. 300 on Map.

Located in Cabin Creek district, on Ten Mile Fork of Cabin creek, ½ mile south of Leewood:

	Thickness Ft.	In.			
Slate roof.					
Slate	1	0			
Coal, sulphur streak near top	3	3			
Slate	0	0¼	....	3'	10¼"
Coal	0	7			

Slate floor; Elev. 1019' A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Red Warrior). No. 301 on Map.

Located in Cabin Creek district, on Twomile Fork of Cabin creek, one mile southwest of Leewood:

	Thickness Ft.	In.			
Slate					
Coal, soft, sulphur streak 9" below top	3	6			
Coal, hard	0	5			
Coal, soft	0	7	....	5'	5"
Slate	0	5			
Coal, soft	0	6			

Slate floor; Elev. 102' A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Buckeye Mine). No. 302 on Map.

Located in Cabin Creek district, on Tenmile fork of Cabin creek, 1½ miles southwest of Leewood:

	Thickness Ft.	In.			
Slate roof.					
Coal, soft	2	4			
Coal, hard	1	1	....	4'	7½"
Slate	0	0½			
Coal, soft	1	2			

Slate floor; Elev. 1118' A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Empire Mine). No. 303 on Map.

Located in Cabin Creek district, on east side of Tenmile fork of Cabin creek, 1½ miles southwest of Leewood:

	Thickness Ft.	In.			
Slate roof.					
Coal, soft	2	7			
Coal, gray splint	0	8			
Coal, soft	0	5	....	5'	4½"
Slate	0	0½			
Coal, soft	1	8			

Slate floor; Elev. 1157' A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Keystone Mine). No. 304 on Map.

Located in Cabin Creek district, on east side of Tenmile fork of Cabin creek, 1¾ miles southwest of Leewood:

	Thickness Ft.	In.			
Slate roof.					
Coal, gas	3	0			
Coal, gray splint	0	4			
Coal, gas	0	3	....	4′	5½″
Slate	0	0½			
Coal, gas	0	10			

Slate floor; Elev. 1301′ A. T. L.

Butts, N. 15° W.; faces, N. 75° E.

Coal shipped east and west for steam and other fuel purposes.

Cabin Creek Consolidated Coal Co. (Tulip Mine). No. 305 on Map.

Located in Cabin Creek district, on west side of Tenmile fork of Cabin creek, 1¾ miles southwest of Leewood:

	Thickness Ft.	In.			
Slate roof.					
Coal, good	4	4			
Slate	0	1	....	5′	5″
Coal gas; Elev. 1259′ A. T. L.	1	0			

Butts, N. 15″ W.; faces, N. 72 ° E.

Coal shipped east and west for steam and general fuel purposes.

Cabin Creek Consolidated Coal Co. (Shamrock Mine.) No. 306 on Map.

Located in Cabin Creek district, on west side of Tenmile fork of Cabin creek, ½ mile north of Kayford:

	Thickness Ft.	In.			
Slate roof.					
Coal, gas	4	1			
Coal, gray splint	1	0	....	6′	4½″
Slate	0	0½			
Coal, gas	1	3			

Butts, N. 18° W.; faces, N. 72° E.

Coal shipped east and west for steam and other fuel purposes.

Cabin Creek Consolidated Coal Co. (Thistle Mine). No. 307 on Map.

Located in Cabin Creek district, on east side of Tenmile fork of Cabin creek, ½ mile north of Kayford:

	Thickness Ft.	In.			
Slate roof.					
Coal, medium hard	2	2			
Coal, gray splint	0	8	....	4′	10½″
Slate	0	0½			
Coal, soft; Elev. 1358′ A. T. L.	2	0			

Butts, N. 18° W.; faces, N. 72° E.

Coal shipped east and west for steam and other purposes.

Cabin Creek Consolidated Coal Co. (Kayford Mine). No. 308 on Map.

Located in Cabin Creek district, on east side of Tenmile fork of Cabin creek at Kayford:

	Thickness Ft.	In.			
Slate roof, very good.					
Coal, gas	3	7			
Coal splint	1	0	....	5′	10″
Coal, gas; Elev. 1335′ A. T. L.	1	3			

Butts, N. 18° W.; faces, N. 72° E.

Coal shipped east and west for steam and other purposes.

Cabin Creek Consolidated Coal Co. (Raccoon Mine). No. 309 on Map.

Located in Cabin Creek district, on west side of Tenmile fork of Cabin creek, at Kayford:

	Thickness Ft.	In.			
Slate roof.					
Coal, medium hard	0	9			
Coal, gas	2	7			
Coal, gray splint	0	6	....	4′	10½″
Slate	0	0½			
Coal soft; Elev. 1340′ A. T. L.	0	10			

Butts, N 18° W; Faces, N 72° W.

PLATE XXVIII.—Scene at Crescent, ½ mile South of the Kanawha-Fayette County Line, showing the mines of the No. 5 Block Coal, No. 2 Gas and Eagle coals.

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Coal shipped east and west for steam and other purposes.

Quantity of No. 2 Gas Coal Available.

The available quantity of the **No. 2 Gas coal** is given by magisterial districts in the following table, figured on the basis of 25 cubic feet of coal to the short ton.

Table Showing Approximate Available No. 2 Gas Coal.

Districts.	Sq. Miles	Acres.	Thickness of Bed. Ft.	In.	Cubic Feet of Coal.	Short Tons of Coal.
Cabin Creek...	160	102,400	4	6	20,072,448,000	802,897,920
Elk	12	7,680	4	0	1,338,163,200	53,526,528
Loudon	14	8,960	3	3	1,268,467,200	50,738,688
Malden	20	12,800	4	0	2,230,272,000	89,210,880
Total.....	206	131,840			24,909,350,400	996,374,016

The composition, calorific value and fuel ratio are given in the following table of analyses of the **No. 2 Gas coal** from Kanawha county:

Analyses of No. 2. Gas Coal in Kanawha County.

(Under the heading "Condition of Sample": "A. D."=air dried, and "A. R."=[illegible])

Mine No. on Ma.	Mine.	District.	Condition of Sample.	Proximate: Moisture.	Proximate: Volatile Matter.	Proximate: Fixed Carbon.	Proximate: Phosphorus.	Common to both: Ash.	Common to both: Sulphur.	Carbon.	Hydrogen.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
263	Black Band Coal & Coke Co., Carkin Mine	Loudon		0.94	34.19	57.53	0.008	7.34	1.12	....	....	....	....	....	....	....
264	Marmet Coal Co., Butler Mine	Loudon		2.00	28.00	62.07	0.0028	7.93	0.94	76.36	4.44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
264	Marmet Coal Co., Butler Mine	Loudon		1.40	35.05	59.09	0.0028	4.46	0.78	78.55	5.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
264	Marmet Coal Co., Butler Mine	Loudon		1.50	26.60	57.47	0.0056	14.43	1.12	71.45	4.44	7.87	[illegible]	[illegible]	[illegible]	[illegible]
265	Marmet Coal Co., New Butler Mine	Loudon	A. D.	0.64	37.15	57.15	0.005	5.06	1.36	77.59	5.09	9.49	[illegible]	[illegible]	[illegible]	[illegible]
265	Marmet Coal Co., New Butler Mine	Loudon	A. R.	1.37	36.88	56.73	0.005	5.02	1.35	77.03	5.13	10.07	1.4[illegible]	[illegible]	[illegible]	[illegible]
267	Campbells Creek Coal Co., Calderwood Mine	Malden		1.12	36.63	55.05	0.004	7.20	1.16	....	....	....	....	[illegible]	[illegible]	[illegible]
268	Campbells Creek Coal Co., Spring Fork Mine	Malden		0.96	37.42	57.66	0.002	3.96	0.54	....	....	....	....	14[illegible]	[illegible]	[illegible]
269	Virginia Coal Co	Malden	A. R.	1.44	39.97	55.35	0.004	3.24	0.91	78.57	5.44	10.57	1.27	1444[illegible]	[illegible]	[illegible]
272	Hughes Creek Coal Co., Mine No. 4	Cabin Creek	A. D.	1.01	36.80	55.58	0.007	6.61	0.69	78.10	5.27	7.88	1.45	14170	[illegible]	[illegible]
272	Hughes Creek Coal Co., Mine No. 4	Cabin Creek	A. R.	1.28	36.69	55.43	0.007	6.60	0.69	77.87	5.29	8.10	1.45	14130	14[illegible]	[illegible]
276	Cannelton Coal Co., Mine No. 2	Cabin Creek		0.47	35.41	58.47	0.004	5.65	1.06	....	....	....	....	14637	....	[illegible]
277	Eureka Coal Co., Mine No. 1	Cabin Creek		0.51	31.93	57.07	0.0112	10.49	0.71	....	....	....	....	....	....	[illegible]
279	Chesapeake Mining Co., Mine No. 2	Cabin Creek	A. D.	0.75	33.31	60.12	0.006	5.82	1.27	79.69	4.83	7.25	1.14	14204	14073	[illegible]
*279	Chesapeake Mining Co., Mine No. 2	Cabin Creek		1.03	33.22	59.94	0.006	5.81	1.27	79.47	4.86	7.45	1.14	14264	14047	5.[illegible]
280	Lackawanna Coal & Lumber Co., Nuckolls Mine	Cabin Creek	A. D.	1.00	33.05	60.24	0.010	5.71	1.78	79.09	5.44	6.96	1.02	14569	14410	6.2[illegible]
*280	Lackawanna Coal & Lumber Co., Nuckolls Mine	Cabin Creek		1.52	32.88	59.92	0.010	5.68	1.77	78.68	5.50	7.35	1.02	14494	14356	6.04
281	Lackawanna Coal & Lum. Co., Greenbrier No. 2	Cabin Creek	A. D.	0.85	33.60	60.48	0.006	5.07	1.46	79.64	5.67	7.14	1.02	14719	14606	6.52

Analyses of No. 2. Gas Coal in Kanawha County.

(Under the heading "Condition of Sample", "A. D."=Air dried; and "A. R."=A.

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultin.				Calorimeter B. T. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
*281	Lackawanna Coal & Lum. Co., Greenbrier No. 2	Cabin Creek...		1.49	33.39	60.08	0.006	5.04	1.45	79.13	5.74	7.62	1.02	14625	14539	6.25
282	National Bituminous Coal & Coke Co.....	Cabin Creek...	A. R.	0.32	35.12	58.00	0.004	6.56	1.65	77.74	5.01	8.14	0.90	14220	13860	5.29
283	Southern Colliery Co., Mine No. 2.....	Cabin Creek...		1.02	30.93	61.83	0.004	6.22	2.02	76.36	5.56	9.71	0.90	14117	13886	4.79
284	Cabin Creek Cons. Coal Co., Holly Mine.....	Cabin Creek...		1.15	30.45	61.10	0.004	7.30	1.36	77.73	5.11	7.96	1.05	14069	13919	5.09
285	Cabin Creek Cons. Coal Co., Quarrier Mine...	Cabin Creek...		1.15	28.80	64.52	0.003	5.53	1.70	78.27	5.33	8.79	1.03	14166	14107	5.47
286	Wake Forest Mining Co.....	Cabin Creek...		0.70	32.73	62.22	0.002	4.35	1.42	78.55	5.56	9.59	1.05	14610	14184	5.63
287	Carbon Coal Co., North Carbon Mine.....	Cabin Creek...		1.10	28.75	64.56	0.003	5.59	1.18	77.45	5.33	9.92	0.96	14112	13849	4.99
288	Wyatt Coal Co., Berlin Mine.....	Cabin Creek...		1.02	29.58	60.70	0.002	8.70	2.45	74.73	4.89	9.17	0.96	13673	13288	4.18
289	Cabin Creek Cons. Coal Co., Belleclare Mine..	Cabin Creek...		1.55	30.75	62.65	0.002	5.05	1.65	78.27	5.83	8.74	1.06	14552	14391	5.68
290	Carbon Coal Co., South Carbon Mine.....	Cabin Creek...		0.95	28.45	65.17	0.002	5.43	2.14	79.09	5.50	7.52	1.11	14377	14437	6.11
291	Republic Coal Co., Mine No. 1.....	Cabin Creek...		1.30	28.60	62.37	0.002	7.73	1.39	76.91	5.11	8.29	1.11	14025	13766	4.81
292	Republic Coal Co., Mine No. 2.....	Cabin Creek...		1.05	30.10	65.19	0.002	3.66	1.37	79.36	5.67	9.41	1.05	14650	14383	6.07
295	West Va. Colliery Co., Mine No. 1.....	Cabin Creek...		1.25	28.30	66.58	0.004	3.87	0.82	80.46	5.44	8.60	1.13	14720	14446	6.45
296	Cabin Creek Cons. Coal Co., United Mine.....	Cabin Creek...		1.40	26.65	64.86	0.003	7.09	0.69	79.09	5.18	7.13	1.06	14121	14184	5.56
299	Cabin Creek Cons. Coal Co., Cherokee Mine...	Cabin Creek...		1.15	30.45	61.10	0.004	7.30	1.36	77.73	5.11	7.96	1.05	14069	13919	5.09
300	Cabin Creek Cons. Coal Co., Caledonia Mine..	Cabin Creek...		1.05	29.05	62.40	0.003	7.50	1.10	77.45	5.44	7.95	0.96	14219	14056	5.01
301	Cabin Creek Cons. Coal Co., Red Warrior Mine.	Cabin Creek...		0.77	29.58	62.22	0.003	7.43	2.60	77.18	4.89	7.94	0.96	14004	13750	5.02
306	Cabin Creek Cons. Coal Co., Shamrock Mine..	Cabin Creek...		1.48	28.57	64.75	0.003	5.20	0.89	79.09	5.44	8.76	0.96	14529	14230	5.52
307	Cabin Creek Cons. Coal Co., Thistle Mine.....	Cabin Creek...		1.25	27.10	62.42	0.003	9.23	1.14	76.55	4.44	8.08	1.00	13764	13307	4.42
308	Cabin Creek Cons. Coal Co., Kayford Mine....	Cabin Creek...		1.30	28.00	65.49	0.001	5.21	1.10	78.82	5.00	9.22	1.05	14412	13895	5.46
309	Cabin Creek Cons. Coal Co., Raccoon Mine...	Cabin Creek...		0.95	29.27	60.29	0.006	9.49	1.53	75.27	5.33	7.96	1.00	13653	13795	4.31

*Corrected for Moisture.

Analyses of No. 2. Gas Coal in Kanawha County.

(Under the heading "Condition of Sample": "A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
263	Black Band Coal & Coke Co., Carkin Mine	Loudon		0.94	34.19	57.53	0.008	7.34	1.12	.....	.....	.....	.....	.....	.....	.....
264	Marmet Coal Co., Butler Mine	Loudon		2.00	28.00	62.07	0.0028	7.93	0.94	76.36	4.44	9.63	1.04	13116	13125	4.35
264	Marmet Coal Co., Butler Mine	Loudon		1.40	35.05	59.09	0.0028	4.46	0.78	78.55	5.00	10.25	1.26	14042	13752	5.34
264	Marmet Coal Co., Butler Mine	Loudon		1.50	26.60	57.47	0.0056	14.43	1.12	71.45	4.44	7.97	1.01	12655	12353	3.19
265	Marmet Coal Co., New Butler Mine	Loudon	A. D.	0.64	37.15	57.15	0.005	5.06	1.36	77.59	5.09	9.49	1.41	14210	13770	5.33
265	Marmet Coal Co., New Butler Mine	Loudon	A. R.	1.37	36.88	56.73	0.005	5.02	1.35	77.03	5.13	10.07	1.40	14110	13770	5.10
267	Campbells Creek Coal Co., Calderwood Mine	Malden		1.12	36.63	55.05	0.004	7.20	1.16	.....	.....	.....	.....	13755	.....	.....
268	Campbells Creek Coal Co., Spring Fork Mine	Malden		0.96	37.42	57.66	0.002	3.96	0.54	.....	.....	.....	.....	14278	.....	.....
269	Virginia Coal Co	Malden	A. R.	1.44	39.97	55.35	0.004	3.24	0.91	78.57	5.44	10.57	1.27	14440	14020	5.69
272	Hughes Creek Coal Co., Mine No. 4	Cabin Creek...	A. D.	1.01	36.80	55.58	0.007	6.61	0.69	78.10	5.27	7.88	1.45	14170	14040	5.39
272	Hughes Creek Coal Co., Mine No. 4	Cabin Creek...	A. R.	1.28	36.69	55.43	0.007	6.60	0.69	77.87	5.29	8.10	1.45	14130	14000	5.30
276	Cannelton Coal Co., Mine No. 2	Cabin Creek...		0.47	35.41	58.47	0.004	5.65	1.06	.....	.....	.....	.....	14637	.....	.....
277	Eureka Coal Co., Mine No. 1	Cabin Creek...		0.51	31.93	57.07	0.0112	10.49	0.71	.....	.....	.....	.....	.....	.....	.....
279	Chesapeake Mining Co., Mine No. 2	Cabin Creek...	A. D.	0.75	33.31	60.12	0.006	5.82	1.27	79.69	4.83	7.25	1.14	14204	14073	6.10
*279	Chesapeake Mining Co., Mine No. 2	Cabin Creek...		1.03	33.22	59.94	0.006	5.81	1.27	79.47	4.86	7.45	1.14	14264	14047	5.99
280	Lackawanna Coal & Lumber Co., Nuckolls Mine	Cabin Creek...	A. D.	1.00	33.05	60.24	0.010	5.71	1.78	79.09	5.44	6.96	1.02	14569	14410	6.24
*280	Lackawanna Coal & Lumber Co., Nuckolls Mine	Cabin Creek...		1.52	32.88	59.92	0.010	5.68	1.77	78.68	5.50	7.35	1.02	14494	14356	6.04
281	Lackawanna Coal & Lum. Co., Greenbrier No. 2	Cabin Creek...	A. D.	0.85	33.60	60.48	0.006	5.07	1.46	79.64	5.67	7.14	1.02	14719	14606	6.52

Analyses of No. 2. Gas Coal in Kanawha County.

(Under the heading "Condition of Sample", "A. D."=Air dried; and "A. R."=As received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
*281	Lackawanna Coal & Lum. Co., Greenbrier No. 2	Cabin Creek...		1.49	33.39	60.08	0.006	5.04	1.45	79.13	5.74	7.62	1.02	14625	14539	6.25
282	National Bituminous Coal & Coke Co.....	Cabin Creek...	A. R.	0.32	35.12	58.00	0.004	6.56	1.65	77.74	5.01	8.14	0.90	14220	13860	5.29
283	Southern Colliery Co., Mine No. 2.....	Cabin Creek...		1.02	30.93	61.83	0.004	6.22	2.02	76.36	5.56	9.71	0.90	14117	13886	4.79
284	Cabin Creek Cons. Coal Co., Holly Mine.....	Cabin Creek...		1.15	30.45	61.10	0.004	7.30	1.36	77.73	5.11	7.96	1.05	14069	13919	5.09
285	Cabin Creek Cons. Coal Co., Quarrier Mine...	Cabin Creek...		1.15	28.80	64.52	0.003	5.53	1.70	78.27	5.33	8.79	1.03	14166	14107	5.47
286	Wake Forest Mining Co.....	Cabin Creek...		0.70	32.73	62.22	0.002	4.35	1.42	78.55	5.56	9.59	1.05	14610	14184	5.63
287	Carbon Coal Co., North Carbon Mine.....	Cabin Creek...		1.10	28.75	64.56	0.003	5.59	1.18	77.45	5.33	9.92	0.96	14112	13849	4.99
288	Wyatt Coal Co., Berlin Mine.....	Cabin Creek...		1.02	29.58	60.70	0.002	8.70	2.45	74.73	4.89	9.17	0.96	13673	13288	4.18
289	Cabin Creek Cons. Coal Co., Belleclare Mine..	Cabin Creek...		1.55	30.75	62.65	0.002	5.05	1.65	78.27	5.83	8.74	1.06	14552	14391	5.68
290	Carbon Coal Co., South Carbon Mine.....	Cabin Creek...		0.95	28.45	65.17	0.002	5.43	2.14	79.09	5.50	7.52	1.11	14377	14437	6.11
291	Republic Coal Co., Mine No. 1.....	Cabin Creek...		1.30	28.60	62.37	0.002	7.73	1.39	76.91	5.11	8.29	1.11	14025	13766	4.81
292	Republic Coal Co., Mine No. 2.....	Cabin Creek...		1.05	30.10	65.19	0.002	3.66	1.37	79.36	5.67	9.41	1.05	14650	14383	6.07
295	West Va. Colliery Co., Mine No. 1.....	Cabin Creek...		1.25	28.30	66.58	0.004	3.87	0.82	80.46	5.44	8.60	1.13	14720	14446	6.45
296	Cabin Creek Cons. Coal Co., United Mine.....	Cabin Creek...		1.40	26.65	64.86	0.003	7.09	0.69	79.09	5.18	7.13	1.06	14121	14184	5.56
299	Cabin Creek Cons. Coal Co., Cherokee Mine...	Cabin Creek...		1.15	30.45	61.10	0.004	7.30	1.36	77.73	5.11	7.96	1.05	14069	13919	5.09
300	Cabin Creek Cons. Coal Co., Caledonia Mine..	Cabin Creek...		1.05	29.05	62.40	0.003	7.50	1.10	77.45	5.44	7.95	0.96	14219	14056	5.01
301	Cabin Creek Cons. Coal Co., Red Warrior Mine.	Cabin Creek...		0.77	29.58	62.22	0.003	7.43	2.60	77.18	4.89	7.94	0.96	14004	13750	5.02
306	Cabin Creek Cons. Coal Co., Shamrock Mine..	Cabin Creek...		1.48	28.57	64.75	0.003	5.20	0.89	79.09	5.44	8.76	0.96	14529	14230	5.52
307	Cabin Creek Cons. Coal Co., Thistle Mine.....	Cabin Creek...		1.25	27.10	62.42	0.003	9.23	1.14	76.55	4.44	8.08	1.00	13764	13307	4.42
308	Cabin Creek Cons. Coal Co., Kayford Mine....	Cabin Creek...		1.30	28.00	65.49	0.001	5.21	1.10	78.82	5.00	9.22	1.05	14412	13895	5.46
309	Cabin Creek Cons. Coal Co., Raccoon Mine...	Cabin Creek...		0.95	29.27	60.29	0.006	9.49	1.53	75.27	5.33	7.96	1.00	13653	13795	4.31

*Corrected for Moisture.

Page Reference to Detailed Description and Sections of Coal Openings and Mines Listed in Preceding Table.
No. 2 Gas Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
263	Bul. II p. 276 No. 3	Black Band Coal & Coke Co., Carkin....	534
264	Vol. II(A) p. 355	Marmet Coal Company, Butler	535
265	369	Marmet Coal Company, New Butler....	535
267	Bul. II p. 276 No. 1	Campbells Creek Coal Co., Calderwood..	536
268	Bul. II p. 276 No. 2	Campbells Creek Coal Co., Spring Fork..	537
269	340	Virginia Coal Company.....	537
272	364	Hughes Creek Coal Co., Mine No. 4....	538
276	Bul. II p. 262 No. 10	Cannelton Coal Company, Mine No. 2....	539
277	Bul. II p. 262 No. 13	The Eureka Coal Co., Mine No. 1.....	539
279	Bul. II p. 264-265 No. 5	Chesapeake Mining Co., Mine No. 2.....	540
280	Bul. II. p. 264-265 No. 3	Lackawanna C. & L. Co., Nuckolls.....	540
281	Bul. II p. 264-5 No. 4	Lackawanna C. & L. Co., Greenbrier No. 2	541
282	381	National Bituminous Coal & Coke Co. Mine No. 2	541
283	Vol. II (A) p. 363 No. 2	Southern Colliery Co., Mine No. 2.....	541
284	Vol. II(A) p. 363 No. 3	Cabin Creek Cons. Coal Co., Holly.....	542
285	Vol. II(A) p. 363 No. 11	Cabin Creek Cons. Coal Co., Quarrier....	542
286	Vol. II(A) p. 363 No. 12	Wake Forest Mining Co.	542
287	Vol. II(A) p. 363 No. 15	Carbon Coal Company, North Carbon ...	543
288	Vol. II(A) p. 363 No. 13	Wyatt Coal Company, Berlin	543
289	Vol. II(A) p. 363 No. 14	Cabin Creek Cons. Coal Co., Belleclair..	543
290	Vol. II(A) p. 363 No. 17	Carbon Coal Co., South Carbon	544
291	Vol. II(A) p. 363 No. 18	Republic Coal Co., Mine No. 1.....	544
292	Vol. II(A) p. 363 No. 19	Republic Coal Co., Mine No. 2.....	544
295	Vol II(A) p. 363 No. 16	West Virginia Colliery Co., Mine No. 1..	545

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
296	Vol. II(A) p. 363 No. 20	Cabin Creek Cons. Co., United	546
298	Bul. II p. 264 No. 2	West Virginia Colliery Co., Mine No. 4..	546
299	Vol II(A) p. 363 No. 3	Cabin Creek Cons. Coal Co., Cherokee....	547
300	Vol. II(A) p. 363 No. 4	Cabin Creek Cons. Coal Co., Caledonia..	547
301	Vol. II(A) p. 363 No. 8	Cabin Creek Cons. Coal Co., Red Warrior	547
306	Vol. II(A) p. 363 No. 6	Cabin Creek Cons. Coal Co., Shamrock...	549
307	Vol. II(A) p. 363 No. 7	Cabin Creek Cons. Coal Co., Thistle....	550
308	Vol. II(A) p. 363 No. 5	Cabin Creek Cons. Coal Co., Kayford....	550
309	Vol. II(A) p. 363 No. 9	Cabin Creek Cons. Coal Co., Raccoon....	550

Mr. J. C. Jenkins, Analyst for the Cabin Creek Consolidated Coal Company at Kayford, has kindly furnished the survey the analyses of the **No. 2 Gas coal** from samples taken from the mine by himself, and also the average analyses of this bed for the past five years, as follows:

Analyses of No. 2 Gas Coal in Mines of Cabin Creek Consolidated Coal Company, Made by J. C. Jenkins, Analyst for Said Company, Kayford, W. Va.

Map No.	Mine	Mois.	Vol. Matter	Fixed Carbon	Ash	Sul.	No. Samp.
308	Kayford	0.74%	33.61%	60.03%	5.62%	1.07%	9
309	Raccoon No. 1	0.66%	33.27%	58.74%	7.35%	1.23%	9
307	Thistle	0.77%	33.49%	60.07%	5.67%	1.21%	5
309	Shamrock	0.65%	34.25%	58.47%	6.63%	1.27%	7
304	Keystone	0.57%	35.50%	58.65%	5.28%	1.30%	7
303	Empire	0.58%	36.13%	57.63%	5.66%	1.46%	4
302	Buckeye	0.89%	34.67%	57.45%	6.99%	1.26%	2
305	Black Tulip...	0.85%	58.17%	34.48%	6.50%	1.39%	2
301	Red Warrior..	0.77%	35.18%	56.01%	8.04%	1.71%	2
300	Caledonia	0.60%	35.26%	57.08%	7.06%	1.43%	2
299	Cherokee	0.50%	36.18%	56.18%	7.14%	1.97%	2
284	Holly	1.08%	34.73%	57.13%	7.06%	1.41%	4
285	Quarrier	0.93%	34.27%	58.28%	6.52%	1.09%	4
289	Belleclare	0.65%	32.47%	58.52%	8.36%	1.60%	2
296	United No. 1..	0.61%	33.02%	60.56%	5.81%	0.91%	8
	Average ...	0.66%	31.10%	61.59%	5.85%	1.35%	

B. T. U. 14,217

Composite sample mine allotment.....	0.73%	33.43%	59.62%	6.22%	1.308% B. T. U. (dry)	14,576
Average of five years' work.....	0.80%	33.39%	58.90%	6.79%	1.13% B. T. U. (wet)	14,327
					(dry)	14,450

The Powellton Coal

The Powellton coal is the next bed of economic importance, in descending order.

LOUDON DISTRICT.

The Powellton coal is mined for local use, on Left Fork of Lens creek, by Scraggs and Smith, on property of Low and Butler, where the following section was measured:

Scraggs and Smith Opening.—No. 310 on Map.

Located in Loudon district, on Left Fork of Lens creek, 3 miles south of Marmet P. O.:

		Thickness Ft.	In.		
1.	Shaly, slate				
2.	Coal, hard, block.....	2	6	....	3' 9"
3.	Slate, with layers of coal.....	1	3		
4.	Slate; Elev. 700' A. T. B.				

No. 2 was sampled for analysis from which Mr. Krak reports the following result:

Proximate Analysis.

	Per cent.
Moisture	1.22
Volatile Matter	38.99
Fixed Carbon	55.95
Ash	3.84
Total	100.00
Sulphur	0.67
Phosphorus	0.014

On Jarrolls hollow of Lens creek the following section was measured:

Low and Butler Estate Prospect Opening.—No. 310A on Map.

Located in Loudon district, on Jarrolls hollow of Left fork of Lens creek:

	Thickness Ft.	In.
Slate roof.		
Coal	1	10
Slate floor; Elev. 657' A. T. B		

A sample was taken for analysis from which Mr. Krak reports the following results.

SAMPLE AS RECEIVED.

Proximate Analysis.	Per cent.	Ultimate Analysis.	Per cent.
Moisture	0.48	Carbon	79.05
Volatile Matter	43.62	Hydrogen	5.75
Fixed Carbon	53.59	Oxygen	10.81
Ash	2.31	Nitrogen	1.48
		Sulphur	0.60
Total	100.00	Ash	2.31
Sulphur	0.60		
Phosphorus	0.003	Total	100.00

Calorimeter B. T. U., 14,330
Calculated B. T. U., 14,250

CABIN CREEK DISTRICT.

The Powellton coal appears in the K. & M. Ry. cut, just north of Montgomery, a section of which is given on page 286 of this report. The coal is also mined, in a commercial way, on Paint creek, by the Lackawana Coal & Lumber Company, at the Grose Mine No. 311 on Map, as described on page 287 of this report.

On Long Branch of Fifteen Mile Fork of Cabin creek, the following section of the **Powellton coal** appears in the bank along the branch:

	Thickness Ft.	In.		
Slate	1	0		
Coal	1	0		
Slate	0	1	.... 3'	1"
Coal, gas	2	0		
Fire clay floor; Elev. 1490' A. T. B.				

In the section at South Carbon on Cabin creek, the

Powellton coal appears 20 feet under the **No. 2 Gas bed** and is 3 feet thick.

A sample of this coal was analyzed in the laboratory of the Carbon Coal Company, at Carbon, which gave the following results, according to Mr. W. E. James, Supt., and General Manager of the company:

	Per cent.
Moisture	0.71
Volatile Matter	31.38
Fixed Carbon	64.37
Ash	3.54
Total	100.00
Sulphur	0.75
B. T. U.	14,997

The above analyses indicate that the coal is of excellent quality.

Quantity of Powellton Coal Available.

In estimating the available tonnage of this coal in Kanawha county field, the writer feels safe in assuming an average thickness of 2 ft. 6 in. spread over an area of 40 sq. miles in the southern portion of Cabin Creek district, and figured on the basis of 25 cu. ft. to the short ton, the following results are obtained:

Table Showing Approximate Available Powellton Coal.

District	Sq. Miles	Acres	Thick- of bed. Ft.	In.	Cubic Feet of Coal	Short Tons
Cabin Creek	40	25,600	2	6	2,787,840,000	111,513,600

The composition, calorific value and fuel ratio are given in the following table of analyses of the **Powellton coal** from Kanawha county:

Analyses of the Powellton Coal in Kanawha County.

(Under the heading "Condition of Sample": "A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine	District	Horizon	Condition of Sample	Proximate				Common to both		Ultimate					Calorimeter B. T. U. for 1 lb. of coal	Calculated B. T. U. for 1 lb. of coal	Carbon divided by Oxygen+Ash
					Moisture	Volatile Matter	Fixed Carbon	Phosphorus	Ash	Sulphur	Carbon	Hydrogen	Oxygen	Nitrogen				
310A	Butler Estate.....	Loudon.....	Powellton..	A. R.	1.22	38.99	55.95	0.014	3.84	0.67	.....	.....	.....	.....	.....	.....	.....	.....
310	Butler Estate.....	Loudon.....	Powellton..	A. R.	0.48	43.62	53.59	0.003	2.31	0.60	79.05	5.75	10.81	1.48		14330	14250	6.02

The Eagle Coal.

The Eagle coal is the next bed of economic importance in descending order in the Kanawha series. A full description of its stratigraphy, distribution, structure and thickness in Kanawha county has been given on pages 289-292 of this report.

The bed is mined and shipped commercially in the southern part of Cabin Creek district on Cabin and Paint creeks.

Carbon Coal Company, Eagle Mine.—No. 311 on Map.

Located in Cabin Creek district, at Nabob P. O., 1 mile north of Decota:

	Thickness Ft.	In.			
Sandstone, massive.					
Coal, impure	1	6			
Fire clay	2	0			
Slate	0	4			
Coal, gas, columnar	1	3	....	10′	6″
Fire clay	1	3			
Coal, gas	1	7			
Slate, full of sulphur	0	1			
Coal, gas, good	2	6			

Fire clay floor; Elev. 1130′ A. T. B.

The coal is shipped east and west for steam and fuel purposes.

Lackawanna Coal & Lumber Co., Detroit Mine. No. 312 on Map.

Located in Cabin Creek district at Detroit; measurements made by Ray V. Hennen and published in Vol. II(A), page 338, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Sandstone.					
2.	Coal, soft, gas	0	4½			
3.	Slate, gray	0	1½			
4.	Coal, soft	0	1½			
5.	Fire clay, hard gray	0	8			
6.	Coal, soft	0	4	....	4′	3½″
7.	Coal, splinty	0	4			
8.	Coal, soft	1	1			
9.	Coal, splinty	1	6			

Fire clay floor; Elev. 940′ A. T. B., taken by D. D. Teets, Jr.

Butts, N. 75° E.; Faces, N. 15° W.

PLATE XXIX.—Eagle Coal. Milburn Mine, Keeferton, 3 miles East of the Kanawha-Fayette County Line.

STANFORD LIBRARY

Coal shipped east and west by rail for steam and domestic purposes. Sample for analysis taken from 2, 6, 7, 8 and 9.

Lackawanna Coal & Lumber Co. Morton Mine No. 5. No. 313 on Map.

Located in Cabin Creek district, on Paint creek, near Morton. Measurement made by Ray V. Hennen and published in Vol II(A) on page 338, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Sandstone roof.					
2.	Coal, splint	3	0			
3.	Slate, black	0	2	....	4'	2"
4.	Coal, softer	0	7			
5.	Coal, cannel; Elev. 1016' A. T. B.	0	5			

Butts, N. 75° E.; Faces, S. 15° E.

Coal shipped east and west by rail for steam and domestic purposes. Sample for analysis taken from Nos. 2, 4 and 5.

A sample of the cannel coal No. 5 at bottom of the bed was analyzed separately, with the following results:

Proximate Analysis.		Ultimate Analysis.	
Moisture	0.25	Carbon	78.00
Volatile Matter	41.20	Hydrogen	4.89
Fixed Carbon	48.72	Oxygen	5.08
Ash	9.83	Nitrogen	1.25
Sulphur	1.50	Ash	9.83
Phosphorus	0.02	Sulphur	0.95
Calculated B. T. U.	14,018	Calorimeter B. T. U.	14,396

Lackawanna Coal & Lumber Co., Morton Mine. No. 314 on Map.

Located in Cabin Creek district, on Paint creek, ¼ mile north of No. 313; measurements made by Ray V. Hennen and published in Vol. II(A), page 339, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Sandstone roof.					
2.	Coal, splinty	0	5			
3.	Coal, soft, gas	1	0	....	3'	8"
4.	Coal splinty	1	0			
5.	Coal, soft	1	3			
6.	Fire clay.					

Butts, N. 75° E.; Faces, S. 15° E.

Coal shipped east and west by rail for steam and domestic purposes.

Lackawanna Coal & Lumber Co., Grose No. 1 Mine. No. 315 on Map.

Located in Cabin Creek district, near Tomsburg, one-fourth mile above mouth of Tom Branch, on east side of Paint Creek. Measurements made by Ray V. Hennen and published in Vol. II (A), page 339, West Virginia Geological Survey, 1908:

		Thickness Ft.	In.			
1.	Sandstone, visible	25	0			
2.	Shales, sandy	4	0			
3.	Coal, soft	1	2			
4.	Fire clay, 8" slate at base	2	4			
5.	Coal, soft	1	6	....	6′	11″
6.	Coal, splinty	0	9			
7.	Coal, soft. Elev. 1182′ A. T. B.	1	2			

Butts, N. 75° E.; faces, S. 15° E.; greatest rise, S. 15° E.

Coal shipped east and west for steam and general fuel purposes; samples from Nos. 5, 6 and 7 were taken for analysis.

"From the top of the fire clay No. 4, a fossil tree trunk 10 inches in diameter projects vertically upward through No. 3 coal, and the overlying shales and sandstone for 10 feet or more, and another one in an erect position is visible near the entrance to the mine."

The Imperial Colliery Co., Mine No. 2.—No. 316 on Map.

Located in Cabin Creek district, on Ten-Mile Fork of Paint Creek, one-half mile southwest from Burnwell and on north side of Ten-Mile Fork. Measurement made by Ray V. Hennen and published in Vol. II (A), on pages 339 and 340.

		Thickness Ft.	In.			
1.	Sandstone, very massive	60	0			
2.	Shales, sandy	4	0			
3.	Coal, soft, "rider"	1	0			
4.	Sandy beds and shale	5	0			
5.	Coal	0	3			
6.	Slate	0	6			
7.	Coal, soft	1	6	....	4′	9″
8.	Coal, hard, splint	1	6			
9.	Coal, soft	1	0			
10.	Fire clay floor. Elev. 1200′ A. T. B.					

Butts, N. 75° E.; faces, S. 15° E.; greatest rise, S. 15° E.

Coal shipped east and west for steam and domestic purposes. Sample taken from Nos. 8, 9 and 10 for analysis.

A separate sample was analyzed from No. 5, with the following results:

Proximate Analysis.

	Per cent.
Moisture	1.00
Volatile Matter	30.20
Fixed Carbon	63.43
Ash	5.37
	100.00
Sulphur	1.24
Phosphorus	.016
Calculated B. T. U.	14,027

Ultimate Analysis.

	Per cent.
Carbon	76.91
Hydrogen	5.78
Oxygen	10.00
Nitrogen	1.17
Ash	5.37
Sulphur	1.24
	100.00
Calorimeter B. T. U.	14,662

It is a difficult matter to determine the approximate available **Eagle coal** in Kanawha county, but the writer has assumed that this bed is of commercial thickness and purity in the southern and eastern part of Cabin Creek district, and that there is an area of 45 square miles in this bed, with an average thickness of 4 ft., and figuring on the basis of 25 cu. ft. of coal to the short ton, the following results are obtained:

Table Showing Approximate Available Eagle Coal.

District.	Sq. Mi.	Acres.	Thickness Ft.	Thickness In.	Cubic Feet of Coal.	Short Tons.
Cabin Creek	45	28,800	4	0	5,018,112,000	200,724,480

The following table gives the comparative calorific value and fuel ratio of the coal in the **Eagle bed** in Kanawha county:

Analyses of the Eagle Coal in Kanawha County.

(Under the heading "Condition of Sample": "A. D."=air dried, and "A. R."=as received.)

Mine No. on Map.	Mine.	District.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of Coal.	Calculated B. T. U. for 1 lb. of Coal.	Carbon divided by Oxygen + Ash.
				Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
312	Lackawanna Coal & Lbr. Co., Detroit Mine...	Cabin Creek	A. D.	1.30	32.30	60.69	0.055	5.71	0.73	79.91	5.33	7.44	1.16	14528	14306	6.08
*312	Lackawanna Coal & Lbr. Co., Detroit Mine...	Cabin Creek		2.08	32.05	60.20	0.055	5.67	0.73	79.28	5.42	8.03	1.15	14414	14290	5.78
313	Lackawanna Coal & Lbr. Co., Morton No. 5..	Cabin Creek	A. D.	1.00	29.10	64.67	0.078	5.23	0.78	79.09	5.56	8.50	1.14	14671	14313	5.76
*313	Lackawanna Coal & Lbr. Co., Morton No. 5..	Cabin Creek		1.66	28.91	64.23	0.078	5.20	0.78	78.57	5.63	8.98	1.14	14574	14243	5.54
‡313	Lackawanna Coal & Lbr. Co., Morton No. 5..	Cabin Creek	A. D.	0.25	41.20	48.72	0.002	9.83	1.50	78.00	4.89	5.08	1.25	14396	14018	5.23
314	Lackawanna Coal & Lbr. Co., Morton No. 1..	Cabin Creek	A. D.	0.75	35.20	60.71	0.055	3.34	0.73	81.81	5.11	8.06	1.23	14902	14459	7.18
*314	Lackawanna Coal & Lbr. Co., Morton No. 1..	Cabin Creek		1.34	35.00	60.34	0.055	3.32	0.73	81.33	5.18	8.49	1.23	14814	14401	6.89
315	Lackawanna Coal & Lbr. Co., Grose No. 1....	Cabin Creek	A. D.	0.75	30.45	64.97	0.055	3.83	0.76	79.91	5.78	8.85	1.15	14818	14533	6.30
*315	Lackawanna Coal & Lbr. Co., Grose No. 1....	Cabin Creek		1.55	30.21	64.44	0.055	3.80	0.76	79.27	5.87	9.44	1.14	14700	14448	5.99
316	Imperial Colliery Co., Mine No. 2.....	Cabin Creek	A. D.	0.80	32.28	63.82	0.001	3.10	0.65	80.18	5.56	9.38	1.38	14996	14400	6.42
*316	Imperial Colliery Co., Mine No. 2.....	Cabin Creek		1.04	32.20	63.67	0.001	3.09	0.65	79.99	5.59	9.55	1.38	14960	14378	6.33
317	Imperial Colliery Co., Mine No. 3.....	Cabin Creek	A. D.	0.65	30.45	64.69	0.007	4.21	0.67	79.64	5.56	9.00	1.19	14607	14353	6.03
*317	Imperial Colliery Co., Mine No. 3.....	Cabin Creek		1.45	30.21	64.16	0.007	4.18	0.67	79.00	5.65	9.59	1.18	14490	14346	5.74
318	Imperial Colliery Co., Mine No. 1.....	Cabin Creek	A. D.	0.80	30.20	65.29	0.097	3.71	0.67	79.91	5.56	9.28	1.14	14767	14340	6.15
*318	Imperial Colliery Co., Mine No. 1.....	Cabin Creek		1.71	29.97	64.64	0.097	3.68	0.67	79.18	5.66	9.95	1.13	14631	14286	5.81
	Average	.....		1.14	31.98	62.35	0.047	4.53	0.77	79.67	5.49	8.64	1.20	14685	14341	6.05

*Corrected for Moisture.

‡5" Cannel coal at bottom.

Page Reference to Detailed Description and Section of Coal Openings and Mines Listed in Preceding Table.
Eagle Coal.

Map No.	Laboratory No.	Name of Owner.	Page of this Report.
312	Vol. II (A) p. 347, No. 10	Lackawanna Coal & Lbr. Co., Detroit....	560
313	Vol. II (A) p. 347, No. 11	Lackawanna Coal & Lbr. Co., Morton No. 5	561
314	Vol. II (A) p. 347, No. 13	Lackawanna Coal & Lbr. Co., Morton No. 1	561
315	Vol. II (A) p. 347, No. 14	Lackawanna Coal & Lbr. Co., Grose No. 1	562
316	Vol. II (A) p. 347, No. 15	Imperial Colliery Co., Mine No. 2.....	562
317	Vol. II (A) p. 348, No. 16	Imperial Colliery Co., Mine No. 3.....	563
318	Vol. II (A) p. 348, No. 17	Imperial Colliery Co., Mine No. 1.....	563

THE LITTLE EAGLE COAL.

The Little Eagle coal is the next bed in descending order, but since it is thin in southern Kanawha county, as shown in the section on preceding pages, it does not appear to have any present commercial or economic value, and no attempt will be made to calculate the approximate available coal in this bed.

The War Eagle and **New River coals** also appear to be absent, or represented only by thin beds of slate and impure coal as shown in the core drill hole at Keeferton published in this report.

SUMMARY OF AVAILABLE COAL IN KANAWHA COUNTY.

It is possible that there is more coal in some of the lower beds, that is, in the **No. 2 Gas** and **Eagle coals** throughout the eastern part of Kanawha county, as revealed in the logs of the wells drilled for oil and gas. However, these records are very unreliable data as to the character and thickness of coals penetrated, since the ordinary well driller is interested only in getting down as soon as possible to the oil and gas horizons and does not exercise sufficient care to obtain the exact depth at

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which the coal is reached and the thickness of same. Hence the writer hesitates to make even an approximate estimate on such meager information. If at some later date, it should be proven by core drill holes that these coals exist over a considerable area, several million tons of coal can be added to the available coal resources of Kanawha county.

Table Showing Available Coal.

	Short Tons.
Pittsburgh Coal	252,418,003
No. 5 Block coal	1,304,731,797
Stockton-Lewiston coal	1,442,707,100
Coalburg coal	439,363,584
Winifrede coal	263,751,896
Thacker coal	17,656,320
Cedar Grove coal	407,930,688
Peerless coal	464,175,360
No. 2 Gas coal	996,374,016
Powellton coal	111,513,600
Eagle coal	200,724,480
Grand total	5,901,346,844

Table Showing Available Coal by Districts.

Big Sandy District.

	Short Tons.	
No. 5 Block coal	173,961,216	
Stockton-Lewiston coal	229,996,800	
Total		403,958,016

Cabin Creek District.

	Short Tons.	
No. 5 Block coal	278,784,000	
Stockton-Lewiston coal	334,540,800	
Coalburg coal	334,540,800	
Winifrede coal	200,724,440	
Cedar Grove coal	334,540,800	
Peerless	376,358,400	
No. 2 Gas coal	802,897,920	
Powellton coal	111,513,600	
Eagle coal	200,724,480	
Total		2,974,625,240

Charleston District.

	Short Tons.	
No. 5 Block coal	96,645,050	
Stockton-Lewiston coal	19,514,880	
Winifrede coal	2,972,982	
Total		119,132,912

Elk District.

	Short Tons.	
Pittsburgh coal	6,690,816	
No. 5 Block coal	368,028,034	
Stockton-Lewiston coal	418,176,000	
Coalburg coal	33,454,080	
No. 2 Gas coal	53,526,528	
Total		879,875,458

Jefferson District.

	Short Tons.	
Pittsburgh coal	223,027	
Total		223,027

Loudon District.

	Short Tons.	
No. 5 Block coal	234,178,560	
Stockton-Lewiston coal	217,451,420	
Winifrede coal	23,782,554	
Thacker coal	17,656,320	
Cedar Grove coal	60,217,344	
Peerless coal	50,181,120	
No. 2 Gas coal	50,738,688	
Total		654,206,006

Malden District.

	Short Tons.	
No. 5 Block coal	49,070,445	
Stockton-Lewiston coal	66,908,160	
Coalburg coal	71,368,704	
Winifrede coal	21,745,152	
Cedar Grove coal	13,172,544	
Peerless coal	37,635,840	
No. 2 Gas coal	89,210,880	
Total		349,111,725

Poca District.

	Short Tons.	
Pittsburgh coal	128,414,880	
Total		128,414,890

Union District.

	Short Tons.	
Pittsburgh coal	117,089,280	
Total		117,089,280

Washington District.

	Short Tons.	
No. 5 Block coal	104,064,492	
Stockton-Lewiston coal	156,119,040	
Winifrede coal	14,526,768	
Total		274,710,300
Grand total		5,901,346,844

Of course, from the above estimates, there would have to be subtracted 90 to 100 million tons, representing coal that has already been mined in Kanawha county from the different beds, so that the total coal for the county would be reduced to 5,801,356,834 short tons.

The above estimate of available coal in Kanawha county does not mean that this amount will eventually be recovered. The percentage of recovery of a coal bed, at present, in West Virginia, varies from 60 to 95 per cent of the minable coal. However, by the rapid progress that is being made in mining methods in recent years, in regard to saving the largest possible amount of the bed, the writer is of the opinion that fully 80 per cent of the above estimate will be eventually recovered. Figuring on this basis, the total available coal is reduced in round numbers to 4,641,085,467 short tons.

Core Drill Holes and Well Records.

In addition to the sections of the coals given on the preceding pages of this report, the writer will now give the records of the core drill holes, drilled in the different magisterial districts, where these records are available:

CABIN CREEK DISTRICT.

Two core drill holes have been sunk by Col. J. Q. Dickinson of Charleston, on his lands on Bell creek, to ascertain the

thickness of the lower seams. He has kindly furnished the Survey with a copy of the same as follows:

John Q. Dickinson Core-drill Hole No. 1 (681).

Located in Cabin Creek district on Bell Creek, one mile southeast of Pond Gap. Elevation 975' A. T. B.

	Thickness Ft.	Thickness In.	Total Ft.	Total In.
Surface	10	6	10	6
Hard sandstone and conglomerate	27	5	37	11
Sandy shale	4	7	42	6
Sandstone	4	10	47	4
Sandy shale	12	2	59	6
Sandstone	49	11	109	5
Sandy shale	23	11	135	4
Coal and bone ..... 0' 3"				
Sandy shale ..... 4' 7"				
Coal and bone ..... 0' 2"				
Sandy shale ..... 4' 1"				
Coal ..... 0' 4" } **Winifrede**	10	1	145	5
Sandy shale ..... 0' 2"				
Coal ..... 0' 3"				
Sandy shale ..... 0' 3"				
Coal and bone ..... 0' 3"				
Sandy shale	35	10	181	3
Coal and bone ..... 0' 8"				
Coal ..... 1' 3" } **Chilton**	1	11	183	2
Sandy shale	16	4	199	6
Slate	0	3	199	9
Coal and bone, Thacker	0	5	200	2
Sandy shale	44	4	244	6
Coal and bone	1	1	245	7
Sandy shale	11	1	256	8
Slate	0	7	257	3
Coal, Cedar Grove	0	9	258	0
Fire clay	2	0	260	0
Sandy shale	4	0	264	0
Sandstone	91	11	355	11
Slate	0	11	356	10
Sandy shale	1	3	358	1
Slate	0	2	358	3
Coal, Peerless	1	3	359	6
Sandy shale	11	11	371	5
Slate	6	1	377	6
Coal, No. 2 Gas?	1	6	379	0
Fire clay	0	5	379	5
Sandy shale	3	2	382	7

The top of the hole begins 115 feet below the Kanawha Black Flint, so the coal encountered at 135 ft. 1 in. is the Winifrede coal, and that at 377 ft. is possibly the **No. 2 Gas coal**, thus making the interval between the **No. 2 Gas** and

Kanawha Black Flint, 492 feet, compared with 510 feet at Greendale, published in Vol. II(A), West Virginia Geological Survey, page 462, 1908, located N. 15° E. 6 miles from this core-drill hole.

John Q. Dickinson Core-drill Hole No. 2 (682).

Located in Cabin Creek district, on Bell Creek, 2½ miles southeast of Pond Gap, and one-half mile northwest from the common corner of Clay, Fayette, Kanawha and Nicholas counties. Elevation 900' A. T. B.:

	Thickness		Total	
	Ft.	In.	Ft.	In.
Surface	22	3	22	3
Shale	4	0	26	3
Sandstone	9	0	35	3
Sandy shale	10	4	45	7
Fire clay	0	8	46	3
Coal and bone ..... 0' 3"				
Shale ..... 0' 3" } Winifrede	1	0	47	3
Coal and bone ..... 0' 6"				
Fire clay	0	6	47	9
Sandy shale	1	7	49	4
Sandstone	26	10	76	2
Sandy shale	5	0	81	2
Coal and bone ..... 0' 7"				
Coal ..... 0' 9"				
Coal and bone ..... 0' 2"				
Coal ..... 0' 7" } Chilton	3	1	84	3
Sandstone ..... 0' 1"				
Coal ..... 0' 11"				
Sandy shale	3	0	87	3
Sandstone	4	1	91	4
Green shale	0	3	91	7
Sandstone	14	0	105	7
Sandy shale	1	9	107	4
Coal and bone	0	2	107	6
Shale with coal streaks	0	5	107	11
Fire clay	2	0	109	11
Sandy shale	21	0	130	11
Sandstone	5	3	136	2
Sandy shale	4	7	140	9
Bone and coal, Thacker	0	3	141	0
Coal	0	3	141	3
Sandy shale	24	4	165	7
Slate	1	3	166	10
Shale	0	3	167	1
Coal	0	2	167	3
Fire clay	2	0	169	3
Sandy shale	11	9	181	0
Sandstone	8	4	189	4
Sandy shale	10	0	199	4
Sandstone	57	7	256	11
Sandy shale	16	10	273	9

		Thickness Ft.	Thickness In.	Total Ft.	Total In.
Coal .....1′ 8″ Fire clay .....0′ 8″ Coal and bone .....0′ 2″	Peerless	2	6	276	3
Sandy shale		19	10	296	11
Coal, No. 2 Gas		2	6	299	5
Fire clay		2	10	302	3
Sandy shale		5	2	307	5
Sandstone		6	0	313	5
Sandy shale		3	2	316	7
Coal and bone.....		1	0	317	7
Sandy shale		14	3	331	10
Coal .....1′ 0″ Fire clay ..... 8″ Coal ..... 11″	Powelton	2	7	334	5
Fire clay		2	0	336	5

The well begins 250 feet under the **Kanawha Black Flint,** so that the coal encountered at 46′ 3″ is the Winifrede coal, and that at 299 ft. 5 in. is possibly the No. 2 Gas seam, coming 549 feet under the Kanawha Black Flint, a thickening in this interval of 52 feet in 1.5 miles to the east.

LaFollette et al. Core-drill Hole No. 1 (699).

Located in Cabin Creek district, at mouth of Laurel Fork of Cabin Creek, one-eighth mile northwest of Eskdale P. O. Authority L. M. LaFollette, Charleston, W. Va. Completed 1905. Elevation 840′ A. T. B.

	Thickness Ft.	Thickness In.	Total Ft.	Total In.
Drift	18	0	18	0
Sand rock	5	0	23	0
Dark clay	0	6	23	6
Sand rock	7	6	31	0
Dark shale	3	0	34	0
Sand rock	4	0	38	0
Sandy shale	31	0	69	0
Coal, No. 2 Gas?	1	5	70	5
Dark shale	10	7	81	0
Sand rock	9	0	90	0
Coal	1	6	91	6
Light shale	18	6	110	0
Coal, Powelton?.....	2	8	112	8
Fire clay	6	0	118	8
Sand rock	30	..	148	8
Dark slate	0	4	149	0
Coal, Eagle?	2	6	151	6
Fire clay	9	6	161	0

The Cedar Grove coal appears in the hill at 83 feet above the top of the core-drill hole.

LaFollette Core-drill Hole No. 2 (699B).

Located in Cabin Creek district on Laurel Fork, one mile above its junction with Coal Fork of Cabin Creek, 1.5 miles west of Eskdale P. O. Completed in 1905. Authority, L. M. LaFollette, Charleston, W. Va. Elevation 945' A. T. B.

		Thickness Ft.	In.	Total Ft.	In.
Surface		12	...	12	...
Sand rock		44	...	56	...
Dark shale		14	...	70	...
Sand rock		10	...	80	...
Dark shale		53	...	133	...
Coal, Peerless		2	1	135	1
Dark shale		8	...	143	1
Coal ..... 2' 3"					
Fire clay ..... 8"					
Dark shale ..... 9' 0"	No. 2 Gas	14	5	157	6
Coal ..... 2' 6"					
Sand rock		40	...	197	6
Coal ..... 3' 0"					
Slate ..... 0' 4"	Powelton	3	5	200	11
Coal ..... 0' 1"					
Fire clay		5	...	205	11

The No. 2 Gas coal appears to be split at this point, being separated with a strata of dark shale and fireclay 9 feet 8 inches thick.

The Winifrede Coal Company Core-drill Hole No. 1 (699C).

Located in Cabin Creek district on Fields Creek at Winifrede P. O. The record of this hole is included in the Winifrede section, published on a preceding page of this report.

LOUDON DISTRICT.

The Marmet Coal Company has put down several core-drill holes on their property at Hernshaw, to ascertain the extent and thickness of the seam of coal mined on its property:

The Marmet Coal Company Core-drill Hole No. 1, (646).

Located in Cabin Creek district on head of Huffman hollow, one mile south of Hernshaw P. O. Authority, the Marmet Coal Company. Elevation 1200' A. T. L.

	Thickness Ft.	In.	Total Ft.	In.
Unrecorded	60	..	60	...
Coal, Coalburg	0	8	60	8
Unrecorded	48	0	108	8

		Thickness Ft.	Thickness In.	Total Ft.	Total In.
Coal		0	4	109	0
Unrecorded		43	3	152	3
Coal, Winifrede		2	3	154	6
Unrecorded		32	11	187	5
Coal 0′ 7″ Dark shale 5′ 0″ Coal 1′ 0″	Chilton	6	8	194	1
Dark shale		11	5	205	6
Coal, Thacker?		2	7	208	1
Unrecorded		15	2	223	3
Coal		0	5	223	8
Unrecorded		58	7	282	3
Coal, impure		1	2	283	5
Unrecorded		40	0	323	5
Coal 1′ 2″ Slate and sulphur 0′ 2″ Coal 2′ 3″	Cedar Grove	3	7	327	0
Unrecorded		31	0	358	0
Coal, Peerless?		1	6	359	6
Unrecorded		85	2½	444	8½
Coal 0′ 2¾″ Slate 0′ 3¼″ Coal 3′ 10½″ Fire clay 7½″ Coal 2′ 3½″	No. 2 Gas	7	3½	452	0
Fire clay		2	7½	454	7½

The bed at 205½ feet, provisionally identified with the **Thacker coal,** is 244 feet above the top of the **No. 2 Gas** and is called locally the "Block seam."

Several core-drill holes were put down on Davis creek by the Ault Lumber Company of Cincinnati, but the writer was unable to get the records.

MALDEN DISTRICT.

Mr. D. G. Courtney of Charleston, W. Va., put down four core-drill holes along Campbell creek, on a 5,000 acre tract owned by him, the record of which he has kindly furnished the Survey, as follows:

D. G. Courtney Core-drill Hole No. 1 (675).

Located in Malden district, in Spruce Hollow, one-half mile from its junction with Campbell Creek. Authority, D. G. Courtney. Completed June 11, 1908. Elevation 765′ A. T. B.

	Thickness Ft.	Thickness In.	Total Ft.	Total In.
Surface	7	0	7	0
Sand rock	28	0	35	0
Slaty shale	8	6	43	6

		Thickness Ft.	Thickness In.	Total Ft.	Total In.
Coal ..... 0′ 4″					
Slate parting ..... 1′ 2″	Cedar Grove ..	2	2	45	8
Coal ..... 0′ 8″					
Sand rock		7	4	53	0
Slaty shale		15	0	68	0
Slate		18	0	86	0
Fire clay		1	2	87	2
Slate		1	0	88	2
Sand rock		5	6	93	8
Slate		5	10	99	6
Coal, bone ..... 0′ 4″					
Coal ..... 1′ 1″					
Coal, hard ..... 0′ 8″					
Coal ..... 0′ 11″	Peerless?	3	6	103	0
Coal, bone ..... 0′ 2″					
Coal ..... 0′ 4″					
Sand rock		0	6	103	6
Total depth		...	...	103	6

The top of this boring starts 260 feet under the **Kanawha Black Flint,** so that the coal encountered at 99 ft. 6 in. is possibly the **Peerless,** instead of the **No. 2 Gas coal** sought by Mr. Courtney.

D. G. Courtney Core-drill Hole No. 2 (676).

Located in Malden district, one-half mile south of Slatelick Branch of Campbell Creek, 1.5 miles west of Eight station. Authority, D. G. Courtney. Completed June 27, 1908. Elevation 745′ A. T. B.

		Thickness Ft.	Thickness In.	Total Ft.	Total In.
Surface		6	0	6	0
Sand rock		2	10	8	10
Slate		22	4	31	2
Gray lime		1	6	32	8
Slate		7	0	39	8
Coal ..... 0′ 6″					
Slate, parting ..... 0′ 2″					
Coal ..... 0′ 7″	Cedar Grove....	2	1	42	9
Slate, parting ..... 0′ 1″					
Coal ..... 0′ 9″					
Sand rock		1	0	42	9
Slaty sand rock		8	5	51	2
Slaty shale		14	0	65	2
Sand rock		4	6	69	8
Sandy slate		16	6	86	2
Coal ..... 0′ 11″					
Sandy slate ..... 6′ 9″					
Coal, bone ..... 0′ 5″					
Coal ..... 1′ 6″					
Coal, hard ..... 0′ 1″	No. 2 Gas	12	0	98	2
Coal ..... 1′ 0″					
Slate, parting ..... 0′ 1″					
Coal ..... 1′ 3″					
Bottom		1	1	99	3

The top of the boring starts 330 feet under the base of the **Kanawha Black Flint,** which would make the coal encountered at 86 feet 2 inches **No. 2 Gas coal,** and that at 39′ 8″ the **Cedar Grove bed.**

D. G. Courtney Core-drill Hole No. 3 (677).

Located in Malden district on Paintlick Fork of Campbell Creek, 2.5 miles southwest of Eight station. Authority, D. G. Courtney. Completed July 6, 1913. Elevation 890′ B.

	Thickness Ft.	Thickness In.	Total Ft.	Total In.
Surface	9	6	9	6
Slate	4	9	14	3
Coal	0	9	15	0
Slate	1	0	16	0
Slaty sand rock	6	7	22	7
Slate	1	0	23	7
Coal 0′ 5″ / Slate, parting 0′ 4″ / **Coal** 0′ 2″ } **Chilton**	0	11	24	6
Sandy fire clay	2	0	26	6
Sand rock	4	9	31	3
Slate	1	0	32	3
Coal	0	2	32	5
Shale, dark	6	0	38	5
Slaty sand rock	10	0	48	5
Slate	4	0	52	5
Coal, Thacker?	1	8	54	1
Sandy fire clay	2	0	56	1
Sand rock	7	8	63	9
Slate	5	9	69	6
Sand rock	13	8	83	2
Slate	3	8	86	10
Sand rock	3	0	89	10
Coal	0	3	90	1
Slaty sand rock	5	8	95	9
Slate, sandy	5	2	100	11
Coal, Cedar Grove	1	9	102	8
Slate	1	9	104	5
Sand rock	16	0	120	5
Sandy slate	5	0	125	5
Slate	3	0	128	5
Slaty sand rock	5	10	134	3
Coal, Peerless?	0	8	134	11
Sandy fire clay	4	1	139	0
Slaty sand rock to bottom	11	0	150	0

The well starts 250 feet under the base of the Kanawha Black Flint, so the well did not reach the No. 2 Gas coal, sought by Mr. Courtney.

D. G. Courtney Core-drill Hole No. 4 (678).

Located in Malden district, on Little Ninemile fork, ½ mile from its junction with Campbell creek. Authority, D. G. Courtney. Completed August, 1908. Elevation 910' A. T. B.

	Thickness Ft.	In.	Total Ft.	In.
Surface	5	0	5	0
Slaty sand rock	4	6	9	6
Sand rock	2	0	11	6
Sandy slate	15	11	27	5
Gray lime	2	7	30	0
Slaty sand rock	22	2	52	2
Unrecorded	0	1	52	3
Slaty sand rock	2	9	55	0
Unrecorded	0	2	55	2
Sandy slate	1	1	56	3
Unrecorded	0	1	56	4
Sandy slate	0	6	56	10
Sand rock and coal mixed	0	6	57	4
Sand rock	0	6	57	10
Sandy slate	9	6	67	4
Coal	0	9	68	1
Fire clay	1	0	69	1
Slate	3	5	72	6
Sand rock	4	6	77	0
Slaty sand rock	2	6	79	6
Slate	1	6	81	0
Coal	0	6	81	6
Slaty sand rock	1	6	83	0
Sand rock	1	6	84	6
Gray sandy limestone	4	4	88	10
Slaty sand rock	11	4	100	2
Slate	2	4	102	6
Coal 1' 10" / Slate parting 1' 2" / Coal 0' 6" — Cedar Grove	3	6	106	0
Bottom slate	0	6	106	6
Total Depth	..	..	106	6

The top of this hole begins 240 feet under the base of the Kanawha Black Flint, so that coal encountered at 102 ft. 6 in. is very probably the **Cedar Grove** coal.

Campbell Creek Coal Co. Core-drill Hole No. 1 (679).

Located in Malden district at Putney, W. Va. The record of this well is published in the Putney section on page 189 of this report:

Black Betsey Coal & Mining Co. Core-drill Hole No. 4.

Located on Spring Branch of Frogs creek, Union district, Kanawha County, W. Va. Completed February, 1913. Authority, J. H. Nash, Charleston, W. Va. Elevation 900′ A. T. B.

		Thickness		Total	
		Ft.	In.	Ft.	In.
Surface		13	0	13	0
Sand rock, Gilboy		15	4	28	4
Blue shale		7	2	35	6
Red shale		8	0	43	6
Sandy shale		12	0	55	6
Red shale		12	0	67	6
Blue shale		6	0	73	6
Red shale		15	0	88	6
Blue shale		31	0	119	6
Red shale		24	1	143	7
Blue shale		10	0	153	7
Sand rock		16	5	170	0
Red shale		5	0	175	0
Sandy shale		10	0	185	0
Blue shale		28	10	213	10
Sand rock		22	6	236	4
Blue shale		26	0	262	9
Sandy shale		28	9	291	6
Slate		0	5	291	11
Top Coal....1′ 5″ Draw slate....0′ 7″ Coal ....3′ 3″ Slate and sulphur.0′ 4″	Pittsburgh Coal....	5	7	297	6
Fire clay		3	4	300	10

The above core-drill hole begins at the base of the Dunkard Series, and shows the thickness of the Monongahela Series 297′ 6″. The coals above the Pittsburgh coal in the Monongahela Series appear to be entirely absent.

Black Betsey Coal & Mining Co. Core-drill Hole No. 5.

Located on Spring Branch of Frogs creek, Union district, Kanawha County, West Virginia. Completed February, 1913. Authority, J. H. Nash, Charleston, W. Va. Elevation 730′ A. T. B.

		Thickness		Total	
		Ft.	In.	Ft.	In.
Surface		12	0	12	0
Sand rock		26	8	38	8
Sandy shale		9	0	47	8
Blue and red shale		7	6	55	2
Red shale		13	0	68	2
Blue shale		11	0	79	2
Gray slate		1	7	80	9
Top Coal....1′ 2″ Draw slate....0′ 8″ Coal ....5′ 7″ Bottom Coal....0′ 4″	Pittsburgh Coal....	7	9	88	6
Fire clay		2	4	90	10

CHAPTER XII.

CLAYS, ROAD MATERIALS, BUILDING STONES, SALT INDUSTRY, IRON ORE, FORESTS AND CARBON BLACK.

Professor G. P. Grimsley in Vol. III of the State Geological Survey Reports gives a general review of the clay industry in West Virginia, along with a discussion of the origin, physical and chemical properties, and classification of clays and their uses, to which the reader is referred for interesting data, and the technology of the industry. The following quotation from this volume is pertinent:

*"In the Charleston region there have been a number of brick plants in operation at various times, a number of which have been unsuccessful on account of poor business management rather than on account of the quality of the clays. The first brick paved street in the United States was laid in Charleston in 1872. One block of Summers street, nearest the Kanawha river, was paved with brick set on sand, with a substructure of planks dipped in tar and also resting on sand. †This block is still in use, and the street at this day is in very fair condition. For a number of years after that date, the Charleston brick was shipped into Ohio, and the first brick paved street in Columbus in the early 80's was laid with the Charleston brick, set on tarred planks.

"With the opening of the paving industry in Ohio, the sale of Charleston brick was confined to the State, and in later years they were used mainly for local trade, very few paving brick being shipped away. At the present time no paving brick are made at Charleston.

"Some of the best fire brick in the State were made for a number of years on Elk river, just above Charleston, but at the present time no fire brick are made in this vicinity. Near Charleston are located some deposits of fire clay equal to the best in the State, and to be favorably compared with standard fire clays of the Eastern states. These shales and clays make paving brick of the highest quality, and the deposits are almost unlimited. They burn both buff and red, making fine grades of pressed and ornamental building brick. Here also occur fine grained clays adapted to manufacture of pressed brick and tile, also good stoneware clays.

*Vol. III W. Va. Geological Survey, 1905.

†This paving was relaid since 1911.—(C. E. K.)

"The area of these clays is large, and their location is close to the Great Kanawha Valley coal fields, and gas fuel is also available. Three lines of railroads reach the field, and the Kanawha furnished water transportation for fuel and for the finished product. With all these natural advantages, the Charleston region should be the greatest center of clay industries in the State, but at the present time there are only three small yards using the river clays and one yard using the clay mined in the hill.

"It is difficult to explain the causes of the non-development of this field. There have been some discouraging failures in plants in this region, but in no case have they been due in any degree to the character of the clays. It is hoped that when the natural advantages of this region for clay working in its different lines are fully appreciated capital will come in to develop the field properly Clay products should be shipped out of this territory to supply the trade not only of West Virginia, but of the cities east, south, and even west. A careful examination of the results of the investigation of these clays now to be given, will show their high character, and their location, in part. It must be remembered that the report of these Charleston clays is not complete, and there probably exists other important deposits that were not visited in the course of this investigation. The clays which have been developed near Charleston belong to the Conemaugh Series and the Upper Kanawha Series."

In Kanawha county, at this time, there are three brick plants, manufacturing building and paving brick in the city of Charleston: The W. Va. Clay Products Company, The Standard Brick Company and The Kanawha Brick Company.

West Virginia Clay Products Company.

The location of this plant is given on page 180 and section of their clay mine on page 6 of this volume. A sample of the clay from the mine was collected for analysis, and Mr. Krak, Asst. Chemist of the Survey, reports the following result:

	Per cent.
Silica (SiO_2)	65.54
Ferric Iron (Fe_2O_3)	2.11
Alumina (Al_2O_3)	18.25
Lime (CaO)	0.57
Magnesia (MgO)	0.73
Sodium (Na_2O)	0.48
Potassium (K_2O)	2.34
Titanium (TiO_2)	0.36
Phosphoric Acid (P_2O_5)	0.12
Moisture	4.76
Loss on ignition	5.45
Total	100.71

This plant was formerly the Charleston Fire Brick Company, and on pages 231-233 of Vol. III, West Virginia Geological Survey, the following description is given:

"The plant of this company is located up Elk river two miles from Charleston at Two Mile creek station on the Coal & Coke railroad. It is one of the old brick yards of the Charleston region, and has been used from time to time for the manufacture of fire brick, but it has been idle since 1901. During that year 1,500,000 fire brick were made for the coke ovens of the *Kay Coal Company.

"The capacity of the plant is 25,000 bricks a day. The plant is equipped for the manufacture of stiff-mud building brick, though none has been made for some years. The equipment consists of a nine-foot dry pan, six-foot wooden pug mill, Bucyrus auger of 30,000 capacity, Eagle repress. The building bricks were dried in mine-track tunnel drier heated by fires below. The fire brick were dried on a heated floor large enough to hold 10,000 brick. The building brick were burned in one up-draft kiln, and the fire brick in two round down-draft kilns, 26 feet in diameter, drawing into one stack.

"The river clay from a ten-foot pit near the mill was used for building brick. The fire brick were made from a mixture of one-third flint clay and about two-thirds plastic clay from the mine on the hill back of the plant.

"**Clay Mine.**—The clay is worked in an open pit one mile and a half from the plant on Elk, and 180 feet above the level of the plant. This mine could be reached by wagon road and the clay was formerly hauled to the plant by this route. Later a track was built from the mine around the hill to an incline by cable and across the railroad on raised trestle to be dumped at the mill. This track is now in bad repair but could be renewed at no great cost.

"The clay pit has caved along the banks and the talus covers the flint clay over much of its surface. A section of the pit shows the following layers:

	Feet.
Covers of soil and sandy shale	10 to 25
Sandy shales	4
Buff shale	1
Faint coal blossom	..
Blue shales and clay, plastic	10
Flint clay	4
Buff shales and clay, plastic	10

"Below the pit in the ravine is a massive sandstone and the interval to the bed of the creek is 145 feet. The horizon is apparently lower than the Bakerstown or Barton coal, and may be designated as the Elk fire clay. It is probably the same as that on Two Mile.

"**Chemical Analyses.**—Analyses were made of the flint clay and the overlying blue plastic shales which weather to clay and appear to be very similar to the shales below the flint clay.

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*(Lowmoor Iron Co.)

	Flint clay. Per cent.	Plastic shaly clay Per cent.
Silica	53.41	50.57
Alumina	31.38	30.05
Ferric Iron	1.44	3.43
Ferrous Iron	0.25	0.21
Magnesium	0.06	0.45
Lime	0.22	0.68
Sodium	0.21	0.51
Potassium	1.03	2.02
Water	0.95	1.55
Titanium	1.10	0.81
Phosphorus	0.31	Trace
Loss on ignition	9.74	9.68
	100.10	99.96

"The proportion of fluxes in this flint clay is 3.21, which compares favorably with other good fire clays. The proportion of fluxes in the plastic clay is 7.40. The iron is low in amount and the clays and shales burn buff.

"**Physical Properties.**—Both of these clays slake readily and require about 25 per cent. of water to develop their normal molding consistency. The maximum plasticity in the flint clay is 14, or when weathered, reaches 20, and in the so-called plastic clay is 10. The air shrinkage of the flint clay is 4 per cent., and 6 per cent. in the shale clay. The tensile strength of the flint clay is 63 to 67 pounds, or when weathered, 85 pounds; and in the shale clay the tensile strength is 112 to 115 pounds, or when weathered, 157.

"The first clay does not show incipient fusion until above cone 30 (3146 degrees F.). The plastic clay attains incipient fusion at cone 20 and vitrifies completely at cone 27 with a total fire shrinkage of 3 per cent. Both clays burn to a gray color.

"**Mechanical Analysis.**—The plastic shale clay shows the following proportions of grains of different sizes:

	Range to Millimeters.	Per cent.
Fine clay	.00 to .001	10.0
Coarse clay	.001 to .005	12.5
Silt	.005 to .02	19.6
Fine sand	.02 to .15	13.6
Medium sand	.15 to 1.0	27.2
Coarse sand	1.0 to 3.0	15.6
Water		1.5

The Standard Brick Company.

The Kanawha and New River Fire Brick Company once manufactured brick in Charleston, but the plant is now abandoned, as it was destroyed by fire in 1904, and has been rebuilt as the Standard Brick Company. The following is a short

description of the original plant and mine given in Vol. III, pages 229-231, W. Va. Geological Survey, 1905:

"The plant of this company was built near the close of the year 1902, two and one-half miles west of Charleston on the Kanawha & Michigan railroad. The plant was a very substantial one, with a large equipment of machinery, housed in large and well constructed buildings. The cars were hauled from the mine by electric trolley and the buildings lighted by electricity. It was one of the most expensive plants in the State, but was destroyed by fire in the fall of 1904 and has not been rebuilt. It manufactured fire brick, building brick, and a very high quality of paving block. The destruction of the plant was a great loss to the brick industry of the State.

"The equipment consisted of two nine-foot Stevenson dry pans, one Martin wet pan, twelve-foot plug mill, Freese auger brick machine (Mammoth Junior) of 75,000 capacity, two Raymond represses. The brick were dried in a hot air tunnel drier of eight tunnels, with capacity of 75,000 bricks. The fire brick molded by hand were dried on a floor above the drier tunnels. Hot air was forced into the drier by a large fan. The brick were burned in eight round down-draft kilns, 28 and 30 feet in diameter, holding 40,000 blocks, and in five square down-draft kilns, holding 70,000 blocks. These blocks were made 8½x2⅞x4 inches in size.

"Clay Mine.—The clay mine is located at the side of the county road, over one-half mile north of the plant, and is opened by three entries. The bank at the mine shows the following strata:

	Ft.	In.
Shales, red and buff	30	0
Coal	0	8
Sandstone	30	0
Blue shale	1	0
Clay, red, blue and buff	12	0
Fire clay	5	0
Blue shale	8+	0

"In the manufacture of fire brick, the fire clay was used with a little of the overlying clay added to it. In the manufacture of paving brick, the fire clay and red and blue clays were mixed with the top red and buff shales about half and half

"A short distance south of the mine, a blossom of coal shows at the bend of the road, with a sandstone ledge ten feet above it. The dip to the mine and beyond is very steep, carrying the section below the road in a few hundred yards. A study of this section compared with other sections in this area would indicate that the heavy sandstone above the fire clay and shales in the Buffalo, with the Bakerstown or Barton coal above, covered by the Pittsburgh red shales. The fire clay, blue and red clays would be of the same horizon as the Thornton clay worked near Grafton.

"The fire clay and associated mottled clays are found one mile east, by the road side and up Woodward creek, and of apparently the same quality. Along this creek is a deposit of pottery clay which has not been developed. A pit dug in the fire clay horizon

shows twelve feet of fire clay, red and blue clays. Over 100 feet of the upper shale is exposed on the hill to the west of this creek. Twenty feet of the top of this shale is buff in color, and weathers into fine flaky particles which burn to a good red brick, while the clays and shales at the Kanawha and New River Company's mine burn buff.

"The upper red and buff shales above this mine are tilted in places and the bedding planes are irregular. About five feet from the bottom is a row of limestone nodules some three and four feet in diameter.

Chemical Analyses.

Kanawha and New River Brick Co. Mines.

	Flinty Clay.	Shale.
Silica	54.49	51.07
Alumina	29.94	25.78
Ferric Iron	1.67	3.08
Ferrous Iron	0.04	3.75
Magnesia	0.18	1.26
Lime	0.52	0.57
Sodium	0.21	0.17
Potassium	0.17	3.27
Water	1.53	1.41
Titanium	1.15	1.01
Phosphorus	0.26	0.14
Loss on ignition	10.65	8.70
	100.81	100.21

"Physical Properties.—The flint clay requires 26 per cent. of water to develop a normal molding consistency with a maximum plasticity of 6. Its air shrinkage is 2½ per cent., tensile strength 34 pounds. Its fire shrinkage is 4 per cent., burning nearly white with incipient fusion at cone 27 (3038° F.), and vitrifies at about cone 31 (3182° F.). The maximum plasticity of the shale below the flint clay is 19, air shrinkage 5½ per cent., and tensile strength 57 pounds."

John S. McDonald Fireclay.

Fireclay crops on the John S. McDonald farm at Barlow, in a railroad cut, about ½ mile above Barlow Station.

The clay comes 315 feet under the base of the **Pittsburgh Reds,** and about 38 to 40 above the **No. 5 Block coal.** The following section was measured near the pit:

Barlow Section.

Measured one-half mile above Barlow Station.

	Thickness Feet	Total Feet
Sandstone, massive	60	60
Fire clay, bluish buff	5	65
Sandstone and concealed, East Lynn	30	95
Dark fire clay	2	97
Sandy shale	18	115
Fire clay	2	117
Sandstone and concealed to R. R., (605' A. T. L.)	23	140

Prof. Grimsley in Vol. III, page 233, West Virginia Geological Survey, has the following in regard to this bed:

"An analysis of this clay which is found at various places in the neighborhood shows the following composition:

	Per cent.
Silica	49.81
Alumina	33.85
Ferric Iron	0.68
Ferrous Iron	0.26
Magnesium	0.42
Lime	0.36
Sodium	0.40
Potassium	1.36
Water	1.38
Titanium	1.59
Phosphorus	0.09
Loss on ignition	10.30
	100.51

"With the small percentage of iron this clay should burn buff, since its proportion of fusible elements is low, 3.49 per cent.

"A rational analysis gives the following:

	Per cent.
Free silica	7.05
Feldspar	11.09
Clay substance	81.86

"**Physical Properties.**—This clay slakes in a half minute and requires 18 per cent. of water to bring it to a normal molding consistency Its maximum plasticity is 15, and air shrinkage 6 per cent. The tensile strength is 50 pounds to square inch, or when weathered reaches 104 pounds. Weathering of this clay doubles its strength.

"The clay reaches incipient fusion at cone 14 (2570° F.) vitrification at cone 21 (2822° F.), completed at cone 27, with a total fire shrinkage of 7 per cent.

"The shales found on Two Mile creek and used by the Kanawha and New River Brick Company were traced into the hills to the east near the Hannah farm as described in an earlier section. Shales of the same horizon were found at Barlow a few miles up Elk river, on the McDonald farm about 80 feet above the blue clay described above, from the same farm. Fifteen feet of shales are exposed to the top of the hill, with heavy sandstone below. The horizon of these shales is that of the Pittsburgh red shale, the same as at Morgantown.

"Both of these shales near Charleston burn red, making a high grade building brick, and are accessible to the railroad. The McDonald shale is only a short distance from the Coal & Coke railroad, while that on the Hannah farm is about one-half mile from the Kanawha & Michigan road. Neither deposit has been developed, though both have been tested in a practical way in the local brick yards with marked success. The analyses of these shales show a close resemblance to the Morgantown shale, except they have a higher percentage of ferric iron.

	Hannah farm Per cent.	McDonald farm Per cent.
Silica	54.32	56.78
Alumina	22.01	22.53
Ferric Iron	8.51	5.24
Ferrous Iron	0.37	0.76
Magnesium	1.47	1.32
Lime	0.14	0.68
Sodium	0.27	0.28
Potassium	3.08	3.27
Water	2.54	2.27
Titanium	0.85	0.83
Phosphorus	0.22	Trace
Loss on ignition	6.29	6.43
	100.09	100.39

"These shales are five miles apart, and show a very close agreement in composition, and their physical appearance is similar and in all probability they belong in the Pittsburgh red shale horizon.

"Physical Properties.—Both shales slake very slowly. The Hannah shale requires 30 per cent. of water, and the McDonald shale 25 per cent. of water to develop their normal molding consistency. The maximum plasticity of the former is 10, and of the latter 14. The air shrinkage of both shales is 6 per cent. The tensile strength of the Hannah shale is 100 pounds with a maximum of 111 pounds, and when weathered it reaches 133 pounds to the square inch. The tensile strength of the McDonald shale is 97 pounds with a maximum of 110 pounds, and in weathered shale increases to 140 pounds to the square inch.

"The Hannah shale begins to vitrify at cone 1 (2102° F.), and is completely vitrified at cone 5 (2246° F.), with litt'e shrinkage and burns to red color. The McDonald shale shows incipient fusion at cone 1 (2102° F.) with 11 per cent. fire shrinkage and is vitrified at cone 5 (2246° F.), changing from red to black color."

Kanawha Brick Company.

On pages 262-264 of Vol. III of the same report the following description is given of the Kanawha Brick Company. A section of this mine has already been given on page 180 of this report.

"At the plant of this company, one mile east of town on the Kanawha river, ten feet of river clay is worked, as well as the hard clay from the hills above. The equipment of the plant has been described in the preceding chapter with a description of the hillside clays. The river clay has been used since 1897 in the manufacture of red building brick and is burned in three up-draft kilns.

"This company has another yard on Elk river, one mile from Charleston, which was started by Mr. Isaacs seventeen years ago. The clay is ground in a Potts crusher, tempered in a twelve-foot pug mill and molded on an auger machine of 40,000 capacity, making 25,000 brick daily. The brick are dried in an eight-track steam tunnel drier, holding 72 cars, with 45,000 capacity. The brick are burned in one down-draft kiln, 28 feet in diameter, holding 60,000, and three up-draft kilns, 21 arch, holding 360,000 each, and burned with gas.

"The river clay is 15 feet thick in this pit and is hauled in cars by cable to the plant. The first paving brick probably used in the United States were made from the Kanawha Valley river clays at a point further down the river, by Mr. Isaacs.

"**Chemical Composition.**—The clay from the Kanawha Brick Company yard on the Kanawha river above Charleston, and the yard on Elk river were analyzed, showing the following composition:

	Kanawha yard.	Elk yard.
Silica	66.89	71.02
Alumina	14.52	13.65
Ferric Iron	5.20	4.69
Ferrous Iron	0.59	0.42
Magnesium	0.72	0.84
Lime	0.48	0.59
Sodium	0.71	0.40
Potassium	2.53	2.19
Water	1.54	1.15
Titanium	0.77	0.80
Phosphorus	1.09	0.28
Loss on ignition	4.74	4.23
	98.78	100.26

Mechanical Analysis.

	Range in millimetres	Kanawha yard.	Elk yard.
Fine clay	0.00 to .001	6.5	14.9
Coarse clay	.001 to .005	10.0	5.0
Silt	.005 to .02	46.0	38.0
Fine sand	.02 to .15	32.0	34.0
Coarse sand	.15 to .50	4.0	7.0 (to 3.00 mm)
		1.5	1.1

"These clays burn red on account of their high percentage of ferric iron. While the samples are taken from places two miles apart, they show but slight variation, and the analyses probably represent a fair average composition for the Great Kanawha river alluvial clays.

"**Physical Properties.**—The Kanawha yard clay slakes in one minute and the Elk clay in half a minute. Both require 28 per cent. of water to develop a normal molding consistency. The maximum plasticity of the former is 13, and of the Elk clay, 16. The air shrinkage is 4½ to 5 per cent. The tensile strength of the clay at Kanawha yard is 155 pounds with a maximum of 166. In the Elk yard clay the average tensile strength is 112 pounds with a maximum of 125 pounds.

"The clay from the Kanawha yard reaches incipient fusion at cone 1 (2102° F.) and is almost viscous at cone 5 (2246° F.) Its fire shrinkage is 8 per cent. The clay from the Elk yard reaches incipient fusion at cone 1 (2102° F.), and complete vitrification at cone 5 (2246° F.), and is viscous at cone 10 (2426° F.) Its fire shrinkage is 7 per cent.

"**Buff Building and Fire Brick Company.**—This plant is located about two miles east of Charleston on the Kanawha river and was started in 1903. At the present time they use the river clay, making red building brick. The clay is tempered in a pug mill and molded in an auger machine of 25,000 capacity. The brick are dried in the open yard and burned in three up-draft kilns with eleven, eighteen and twenty-two arches holding 155,000, 285,000 and 350,000 brick. The clay is similar to that of the Kanawha yard and the company owns a tract of buff burning clay in the hills south of the plant, which they plan to use."

ROAD MATERIALS.

Until recently the roads in Kanawha county have received very little attention; but for the past three years considerable interest has developed in road building in the county. The County Court has just (August, 1913) let the contract for the grading and the laying of a concrete bed for a turnpike, three miles in length, extending up Two Mile creek from its mouth, and running toward Sissonville. The road is located on good grade and will be completed, 16 feet wide on top.

Limestone.

The limestones in Kanawha county are practically confined to the Monongahela and Conemaugh series. They are thin and of little use for road materials, their chemical composition, thickness and character, together with a discussion of their crop having been given on preceding pages of this report, to which the reader is referred for specific information.

River and Creek Gravels.

In a former county report (Jackson, Mason and Putnam) prepared by the writer special attention has been directed to the fact that the cheapest and greatest source of good road material, and one that has been nearly always overlooked, is the deposit of gravel along the beds of large streams. In Kanawha county much of this road material can be obtained from the streams. Also the gravel beds of Elk and Kanawha rivers will furnish a large supply of this road material.

BUILDING STONE.

The sandstones of the area under discussion should furnish an almost inexhaustable supply of fair building stone material. The following is a list in descending order of the sandstones that crop to the surface in Kanawha county and that are available and of sufficient thickness and durability to warrant quarrying in some cases for local supply, and in other cases for shipping purposes. Those in **black face type** have already been quarried to some extent. The thickness, character and distribution of these several ledges are discussed at length in this report on pages indicated at the right hand margin of the list.

Monongahela Series:
Uniontown Sandstone 122
Arnoldsburg Sandstone 122
Sewickley Sandstone 123
Upper Pittsburgh Sandstone 123
Conemaugh Series:
Lower Pittsburgh Sandstone 159
Connellsville Sandstone 161
Morgantown Sandstone 164
Grafton Sandstone 168
Saltsburg Sandstone 175
Buffalo Sandstone 178
Allegheny Series:
Upper Freeport Sandstone 201
East Lynn Sandstone 204
Pottsville Series:
Homewood Sandstone 254
Coalburg Sandstone 269
Upper Winifrede Sandstone 272
Lower Winifrede Sandstone 277
Chilton Sandstone 277

Malden Sandstone..... 279
Peerless Sandstone 281
Lower Peerless Sandstone..... 282
Eagle Sandstone 287
Decota Sandstone.....292

Sattes Quarry.—Morgantown Sandstone.

On pages 479-482 of Vol. IV of the State Geological Reports, G. P. Grimsley gives the following account of Sattes Quarry at Sattes, opposite Saint Albans.

"On the north side of the Kanawha river at Sattes, opposite Saint Albans, and 12 miles west of Charleston, Mr. F. A. Sattes operates a sandstone quarry for building stones and grindstones. The adjacent quarry now abandoned, furnished stone for the Kanawha river locks and for bridges on the Kanawha & Michigan railroad.

"The Pittsburgh coal comes in the tops of the hills back of St. Albans, and the interval with allowance for dip would place this sandstone somewhere near the horizon of the Morgantown sandstone; but as there are no key rocks exposed in the hill near this quarry, its place is somewhat doubtful. Dr. I. C. White has recently named the sandstone across the river at St. Albans, the St. Albans Sandstone, and the Sattes quarry would come at this horizon. (See page 88 of this report for the St. Albans section, giving this bed the Morgantown sandstone horizon).

"The rock is blue, also light brown or buff in color. It contains small grains of quartz and has a fine granular texture. In places shale streaks give it a rough appearance, and included clay masses give some of the stone spotted appearance. At the level of the quarry floor is a building containing the grindstone sawing and turning machinery. Both blue and buff stone are used for grindstones which are here usually made 5½ feet in diameter with a 10-inch face, and are claimed to be very satisfactory in use, but this branch of the industry is small. The building stone is shipped to Charleston and other points along the Kanawha & Michigan railroad.

"Quarry.—The floor of the quarry is 90 feet above the K. & M. railroad track. The face runs N 70° W and the old working face is 360 to 400 feet long, while the face of the present working quarry is 60 feet long and worked back 30 to 40 feet.

"The shale roof breaks down into the sandstone, in places cutting it out. At center of the quarry the shale is thus 30 to 40 feet thick and lenses of shale separate ledges of the stone while further along the shale is replaced by sandstone. The shale cover in other parts of the quarry is only 10 to 12 feet. As followed to the east the shale dips down cutting out a large portion of the sandstone. A section of the quarry at the west end shows,

	Feet.
Red soil	2
Red and blue shales	12
Brown and blue sandstone	9
Brown sandstone (Ripple marked)	7
Brown or buff sandstone	8
Buff sandstone	5
Blue fire clay	4

"The underlying blue fire clay contains small nodules of blue limestone through it, and the bedding planes dip strongly to the east. The loading track is 25 feet below the floor of the quarry, and from this level to the quarry is a mass of red and buff shales. The joint planes run N. 60° to 70° W. and N. 25° E. Physical tests on this stone are given in Chapter XXVI.

"**Old Quarry.**—Just east of the above quarry is an old quarry now abandoned. The stone is blue and buff to brown in color, and this quarry face runs with one of the joint planes N 30° E. Some of the rock is foliated with mica planes, and some of the ledges contain poor impressions of plant stems. The rock is hard and even the ledges containing the shale streaks seem to withstand weathering action, though they have acquired rough surfaces, being pitted and furrowed. The stone appears to split readily and very large blocks are piled at the side of the quarry, which furnished stone used especially for bridge piers. A section of this old quarry shows the following structure:

	Ft.	In.
Red shales, finely laminated	20	..
Shaly sandstones	0	10
Buff sandstone	3	..
Buff shale	0	2
Blue sandstone ledge	8	..
Blue sandstone ledge	2	..
Shales	0	10
Blue sandstone, with shale spots	4	..

"The joint planes run N 30° E, also due east and west.

"**Chemical Composition.**—An average lot of stone from the present working quarry was analyzed in the Survey laboratory with the following results:

	Per cent.
Silica and insoluble	88.18
Iron and alumina	8.47
Lime oxide	00.28
Magnesium oxide	0.80
Moisture and loss	2.48

"This analysis shows rather large alumina content, partly from the cement of the sandstone, the feldspars, but probably more from the included clay concretions.

"**Microscopical Structure.**—Mr. S. L. Powell's report on a thin section of this sandstone is as follows: 'The section shows the rock to have been derived from an intimate mixture of round to angular grains of quartz, feldspar, and kaolin, together with some argillaceous matter. Secondary silica is not so abundantly developed, but is sufficient to firmly unite the quartz grains.

" 'The feldspars are mostly altered, giving rise to poikilitic (variegated) areas of secondary minerals, as well as to larger surfaces of calcite, chlorite, and muscovite. There is a considerable amount of iron oxide present which adds its quota to the cement. The cement or bond of the rock is, therefore, a combination of silica and secondary minerals, which with the argillaceous matter fill the interspaces between the grains. The section was badly broken, only fragments remaining, and some of the interstitial matter is lost.' "

The Saltsburg-Buffalo sandstone is quarried and crushed for railroad ballast and concrete at Spring Hill; a description of the bed is given on page 178 of this report.

Buffalo-Mahoning-East Lynn Sandstone.

Near the end of Capitol street and on Elk river at Charleston, several stone quarries are operated. The coals in the Allegheny series are almost completely absent and displaced with sandstone, making a ledge of more than 300 feet thick that was designated the "Charleston Sandstone" by M. R. Campbell in the Charleston folio.

In Vol. II(A), page 548, Dr. I. C. White gives the following section of the measures through the Charleston sandstone horizon:

		Feet.	
1.	Red marly beds of the Conemaugh	50	50
2.	Sandstone, coarse, brown, pebbly, (Saltsburg)	30	80
3.	Coal, (Bakerstown)	3	83
4.	Concealed	10	93
5.	Sandstone, very massive, pebbly, Buffalo	90	183
6.	Fire clay, massive sandstone and concealed East Lynn	100	283
7.	Coal, No. 5 blossom	0	283
8.	Concealed	10	293
9.	Sandstone, massive, (Homewood) to level C. & O.	90	383
10.	Concealed to Kanawha Black Flint at Kanawha river level	30	413

The following descriptions of these quarries are given in Vol. IV, pages 500-504, by Prof. G. P. Grimsley, as follows:

Coal and Coke Railroad Quarry at Charleston, Kanawha County.

"A large sandstone quarry was opened a number of years ago a short distance up Elk river from Charleston to supply stone for the locks and dams on the Kanawha river. In April 1904 the quarry was opened to supply ballast for the railroad and has been open since that time. It is located at the side of the Coal and Coke railroad tracks in the Elk river bluff one mile and a half northeast of Charleston, and is operated by the railroad company. Seventy or eighty men are employed and 250 to 300 yards of ballast quarried and crushed daily. At the present time no building stone is quarried.

"The floor of the quarry is about 30 feet above Elk river, and a small coal is found near the center of the quarry which is probably

one of the Allegheny coals. This sandstone forms the upper portion of the Charleston sandstone of Campbell, or the Buffalo-Mahoning horizon and probably a part of the Freeport.

"The stone is rather fine grained, blue or gray in color with mica flakes through it. It breaks readily into blocks and shows foliation in many ledges. These plants are often curved, but the curved lines finally disappear in the solid stone.

"The face of the quarry runs northeast-southwest at an angle of nearly 45 degrees. It is 350 to 400 feet long, and worked back 40 to 60 feet. A section of the quarry shows:

	Feet.	Inches
Sandy shale	20	...
Sandstone, solid ledge	50	...
Dark shale	1	...
Sandstone	10	...
Coal	0	6
Blue sandstone	80	...

"Above the top of the quarry the sandstone extends 40 to 50 feet higher, but this portion is not quarried. The physical tests on this sandstone are given in Chapter XXVI.

"Chemical Composition.—An average lot of this quarry stone was analyzed in the Survey laboratory with the following results:

	Per Cent.
Silica	90.41
Alumina	4.47
Iron	1.24
Lime oxide	Trace
Magnesium oxide	0.29
Alkalies	1.14
Loss on ignition	2.45

"This analysis shows a considerable percentage of alumina which is probably an important constituent of the cement, as well as a component in the feldspar and mica.

"Microscopical Structure.—Mr. S. L. Powell presents the following report on a thin section of sandstone from the Coal and Coke quarry:

"'This sandstone is composed of grains of quartz, feldspar, and mica, with the quartz predominating. The quartz grains vary from a few rounded to sharply angular and broken forms. There has been considerable development of secondary silica which has enlarged and united the quartz grains into large completely interlocking areas. The extended margins also give the grains a rough, gritty feel on broken surfaces.

"'In the area where the feldspar predominates secondary silica is less abundant, but in its place occur the secondary minerals, chlorite, muscovite, or sericite, and kaolin, also areas of saussurite largely from the decomposition of feldspar. The section also shows some oxide of iron, probably originating from the decomposition of an iron mica. Vermiculite is beautifully developed in certain areas.

"'Feldspar is rather abundant. Some crystals are remarkably fresh and but slightly altered. Some are kaolinized, and others completely altered. The quartz grains show undulatory extinction, and many of them are crushed and broken. They vary in size from a fraction to more than one millimeter in length, and would average about 0.45 millimeter in diameter.'

Patrick Ryan Quarry at Charleston.

"One mile northeast of Charleston up a ravine a short distance from the Coal and Coke quarry, Mr. Patrick Ryan operates a sandstone quarry opened 20 years ago. Ten men are employed and two or three perch of building stone sent out daily during the working season, also 100 to 200 tons of crushed stone for concrete. Its geologic horizon is the same as at the Coal and Coke quarry.

"The sandstone is bluish gray in color, foliated with mica flakes. Some of the stone is banded with wavy red lines due to iron stain, giving a variegated color. In other ledges the stone is nearly pink in color, and the calico stone is characterized by irregular wavy bands of yellow and red through a buff or yellowish rock. The stone readily breaks along the mica planes or along the red streaks. The bands are often cross bedded and more or less curved. On account of the number of bands or planes, the stone can be split into blocks of almost any desired thickness, building blocks, curb, or flagging.

"Quarry.—The face of the quarry runs about 45 degrees northwest, 300 feet long, and worked back 30 to 40 feet. The quarry is located on Coal Branch, and was formerly worked on both sides of the creek.

"At the southeast end of the quarry where the red banded and calico stone occur, the following section was measured:

	Feet.
Shale and soil cover	5
Flaggy sandstone	8
Red banded sandstone ledge	5
Red banded sandstone ledge	2
Red banded sandstone ledge	4
Buff to reddish sandstone	6

"The floor of the quarry here is 12 to 15 feet above the creek. The main joint planes run N. 45° E. and N. 45° W., the latter set forming the face of the quarry. A few planes run N. 80° E. and N. 10° E.

"At the center of the quarry the following ledges were measured:

	Feet.
Soil and shale cover	5
Flaggy sandstone	10
Buff shales	2
Blue sandstone	6
Blue to gray sandstone	10
Sandstone ledge	2
Sandstone ledge	1
Sandstone ledge	2
Sandstone ledge	1
Sandstone ledge	2
Sandstone ledge	1
Sandstone ledge	5
Sandstone, pink or red	1
Sandstone, pink and banded	2
Sandstone, buff to pink	6

"This section shows nearly 40 feet thickness for the quarry face.

Savage Quarry at Charleston.

"Mr. P. M. Savage operates a quarry at north end of Capitol street near the Coal & Coke railroad and the city of Charleston. This quarry is one of the oldest quarries near this city, and the stone

is used for buildings and crushed for concrete. Twenty to thirty men are employed, and 150 to 200 tons of stone are crushed daily in an Austin No. 5 crusher. The stone is said to weigh about 2,700 pounds to the cubic yard.

"This sandstone comes at the horizon of the other Charleston quarries described above. The rock is gray or bluish gray in color with foliation planes through it, giving a banded appearance. The bands are frequently cross-bedded, and the stone splits readily along these planes. In the old exposed portion of the quarry, the stone has weathered to a buff color, and at the north end it is shaly and badly broken on outcrop.

"Through the rock occur nodules and streaks of coal, which are especially abundant about 20 feet from the top of the quarry down to near the base. The cracks and joint planes are coated with a brown discoloration which sometimes extends a few inches into the stone from the fissure lines, and is due to iron in percolating surface waters. Some of the blocks tend to break with a shelly fracture, giving curved surface to the stone. In some parts of the quarry small, round, hard, pebbles of quartz occur, also brown chert or flint fragments.

"Quarry.—The face of the quarry runs north and south, 170 feet long with the old workings extending 80 feet further to the south (See plate XXIII). It has been worked back to the east 75 to 80 feet. A section of the quarry shows the following ledges:

	Feet.	Inches.
Shales and soil cover	10	...
Shaly sandstone	30	...
Sandstone ledge	4	...
Sandstone ledge	3	...
Sandstone ledge	6	...
Sandstone ledge	8	...
Sandstone ledge	10	...
Black shale	0	2 to 4
Sandstone ledge	30	...
Sandstone ledge	16	...

(Not worked at present time.)

"The joint planes run N. 20° W., N. 50° E."

THE SALT INDUSTRY.

The manufacture of salt was one of the first industries in West Virginia, and possibly the first salt was manufactured in the Kanawha Valley by the Indians long before the whites had approached so far westward. According to Dr. J. P. Hale, the first white person to assist in the manufacture of salt was Mrs. Mary Ingles, a captive taken by the Indians from her home in Virginia and brought through the Kanawha Valley in 1753. The Kanawha Valley district was the first to manufacture salt west of the Alleghanies.

In Vol. IV West Virginia Geological Survey, page 300-301, the following account of the salt industry is given by Grimsley:

"The first well was bored for *salt on the Big Kanawha (Kenhawa) river, six miles above Charleston, to a depth of 70 or 80 feet, finding a weak brine which required 400 gallons to make one bushel of salt (50 pounds). Later the wells were drilled to a depth of 350 feet yielding a stronger brine of which 75 gallons were required to make one bushel of salt. The salt area extended 12 to 14 miles along the Kanawha from a point 70 miles above its mouth.

"Hildreth describes the salt rock as a white calcareous sand rock full of fissures and cavities, some inches in diameter. The annual production of salt for a number of years, preceding 1833 was a million bushels, with no apparent decrease in supply of brine. He gives the following analysis of the Kanawha brine and bittern in parts per 1000:

	Brine.	Bittern.
Sodium chloride	56	93
Lime chloride	35	335
Iron carbonate	2	39
Carbonic dioxide	1	0
Water	906	511
Potash	...	22
	1000	1000

"Hildreth states that the production of salt from Kanawha plants in 1833 was 1,200,000 bushels annually. He finds that one pint of this brine weighs 1 pound, 2 ounces, 44 grains, while the river water weighs 1 pound, 1 ounce. This would require 91 gallons of brine to make a bushel of salt. A plant of 30 or 40 kettles required daily 5 to 6 cords of wood. These kettles held 60 to 90 gallons each, set over a stone flue sunk in the earth so as to bring the tops of the kettles nearly on level with soil surface. The pan method of evaporation was also in use."

On pages 301-311 of the same report is an account of the early history of the salt industry in the Kanawha Valley, to which the reader is referred.

On pages 327-331 on the same report the following description is given of salt manufacture in Kanawha county:

MALDEN IN KANAWHA VALLEY.

"The numerous salt work which made the Kanawha valley famous 30 years ago have with one exception disappeared and only here and there remains an old stack or a pile of rubbish to mark their sites. The low price of salt and the discovery of richer brines in more northern districts have forced the companies, one after another, to discontinue operations. The one plant which is still in successful in operation is located at Malden, six miles above Charleston on the Kanawha & Michigan railroad and on the north bank of the Kanawha river. It is located on the old Ruffner property and was built in the spring of 1865. It is owned and operated by Mr. Dickinson under the name of the J. Q. Dickinson Salt Company.

*Following notes from Hildreth, Amer. Jour. Science (series 1), Vol. 24, p. 46, 1833.

"The brine is pumped from a central plant by compressed air from three of the six wells, into a large wooden storage tank, 60 by 25 feet and 4 feet deep, holding 44,800 gallons. The wells are 800 to 900 feet deep with 6½ to 7 inch casing containing a 2-inch brine pipe and one-half inch compressed air pipe.

"From the storage tank, the brine flows down a wooden pipe to the furnace heated by 15 gas jets and a coal fuel is also added, using 60 to 75 tons a week, which is shipped from the company's own mines at Quincy seven miles up the Kanawha & Michigan railroad. The furnace walls are stone lined with fire brick and grate at one end. Above the furnace are the brine pans, three in number, which are about three feet deep, the first one 45 feet wide and 10 feet long; the other two, 30 feet wide and 8 feet long, in which the brine is concentrated from a specific gravity of 1.048 to 1.063 with a salt percentage of 7.1 to 9.3 as received, to a gravity of 1.085 with salt percentage of 12.

"Over these furnace pans is constructed a tight wooden box forming the steam chest, 30 inches high in the clear, which retains the steam which passes through wooden pipes, under 4-pound pressure, to the settlers and grainers. These pipes lead to a horizontal wooden log pipe line at the end of the vats and are connected by goose neck pipes with the five-inch copper pipes running lengthwise of the vats.

"The brine from the furnace pans is colored by the suspended iron oxide, mud and sand, and is drawn off into the upper side of the first mud settler. The two mud settlers are long vats constructed of heavy planks, 165 feet long, 8 to 10 feet wide, 18 inches deep, and divided longitudinally through center by a plank partition. The brine entering the upper side flows to opposite end and there passes over a low place in the partition into the lower side and back to the head of the vat again. It there passes through a pipe into the second mud settler constructed on similar plan and the brine follows a similar course. By the time it reaches the head of the lower side of the second mud settler vat, it is perfectly clear and free of iron, mud and sand. The brine is now ready for use and it has been kept at moderate temperature by the heat of the steam in the copper pipes running through the settlers, one pipe for each half of the settler.

"The brine leaves the second mud settler with a gravity of about 1.125 or with a salt percentage of 17.2 and flows into one of the two settlers which are the same size as the mud settlers but divided by two longitudinal partitions into three compartments. The brine from the settlers passes into the fifth vat or the draw settler which is 165 feet long, 14 feet wide, 45 inches deep without partitions, and having the 5-inch copper steam pipes, and the brine is concentrated to a gravity of 1.170 to 1.179 or 22.5 to 23.6 per cent salt and salt crystals begin to form. It is then conveyed to the four grainers which are plank vats lined with clay tile plates, and are 150 feet long, 10 feet wide, 18 inches deep, and contain three copper steam pipes the full length of the vats. In these the salt is deposited and removed by rakers to the salt cars and conveyed to the storage house.

"After most of the salt is precipitated and the brine has a gravity of 30° Baume, the liquor is drawn into the tenth or bittern vat heated by two copper steam pipes, where it is further concentrated, and the rest of the salt precipitated. This salt is more or less impure and somewhat colored, and is sold for agricultural uses, or at this plant most of it is sold to the Kelley axe factory at Charleston, where it is mixed with other materials to form a tempering mixture for steel When this mother liquor has reached a gravity of 35° B., it is re-

		Thickness Feet.	Total Feet.
Sand, gray, fine.....25'			
Sand, white, fine .....10'			
Sand, buff, ferriferous ....20'			
Sand, gray buff, fine .....20'			
Sand, fine, buff, soft .....10'			
Sand, buff, fine .....10'			
Sand, ferriferous .....10'			
Sand, gray ..... 5'			
Sand, buff, fine, soft .....10'	Upper Salt Sand...	195	675
Sand, buff, very fine .....25'			
Sand, buff, harder .....10'			
Sand, gray, buff ..... 5'			
Sand, yellow, hard, broken. 5'			
Sand, yellow, coarse, hard. 5'			
Sand, buff, hard, ferriferous.10'			
Sand, buff, hard, ferriferous, fine .....10'			
Sand, gray, ferriferous.... 5'			
Lime		5	680
Slate and shells		5	685
Sand, buff, slaty		15	700
Fire clay		5	705
Sand, slaty, soft ..... 5'			
Sand, fine, hard ..... 5'			
Sand, fine, soft ..... 5'			
Sand, buff, soft .....20'			
Sand, buff .....10'			
Slate, gray ..... 5'			
Sand, buff, slaty, ferriferous.10'			
Sand, buff, fine, hard .....10'			
Sand, gray, hard, very fine..10'			
Sand, coarser ..... 7'			
Sand, buff, coarser, soft.... 8'	Lower Salt Sand..	185	890
Sand, gray, very fine, hard 5'			
Sand, buff, fine, soft ..... 5'			
Sand, fine, buff .....15'			
Sand, gray .....30'			
Sand, gray, buff, very fine..10'			
Sand, gray, coarse ..... 5'			
Sand, gray, hard ..... 5'			
Sand, slaty ..... 5'			
Sand, slaty, coarse .....10'			
Slate, hard.....		5	895
Slate and shells, hard.....		30	925
Slate and shells, hard, coarser.....		15	940
Sand, slaty.....		20	960
Lime		35	995
Fire clay		5	1000
Lime		8	1008
Fire clay		4	1012
Slate, limy		2	1014
Total Depth		..	1014

This well produces from 500 to 600 gallons of salt water per hour in salt sand, and this water is being utilized for producing salt.

The above record represents the salt horizon on the Kanawha Valley and the brine makes an excellent grade of salt.

IRON INDUSTRY AND ORE.

A furnace was once erected in Kanawha county at Spring Hill near the mouth of Davis creek, but the supposed blackband ore on Davis creek proved too lean and variable for commercial use, and the furnace was never put in operation There are many nodules and nuggets of iron ore in Kanawha, but no deposits of iron ore of present commercial value.

At 80 feet under the No. 2 Gas coal in Loudon district, there often occurs a thin deposit of iron ore. A sample collected for analysis in Rush creek at mouth of Right Fork two miles northwest of Marmet P. O. gave the following results, as reported by J. B. Krak of the Survey. Laboratory No. 327:

	Per cent.
Silica (SiO_2)	15.01
Metallic Iron	53.66
Lime (CaO)	1.49
Sulphur	0.10
Phosphorus	0.31

FORESTS.

The saw mills, forest fires and the farmers have so depleted the forests, that the available supply of timber is rapidly growing less, and the virgin forests of West Virginia will be practically exhausted at the present rate of consumption in the next 20 to 25 years. A glance at the State Survey map accompanying Vol. V, Forestry and Wood Industry, dated February 1, 1911, will show only a few large tracts of virgin timber in Kanawha county. As timber is very necessary for use in mining, considerable care is taken of the small timber by the coal companies.

On pages 169 and 173 of Vol. V, Mr. Brooks gives the following interesting account of the original and present forest condition and lumber industry of Kanawha county:

Original Timber Conditions.

"Nearly all traces of the original forests have disappeared from the rich bottoms of the Great Kanawha and only here and there in the more remote sections can virgin conditions be found. For this reason, an examination of the area at the present day fails to reveal the nature of the original growth in the sections where the timber grew in greatest luxuriance.

"Fortunately, writers have left a few paragraphs which mention incidentally some of the prevalent timbers of the Kanawha Valley. In his 'History of Kanawha County' Hon G. W. Atkinson says:

" 'The Kanawha Valley was at one time literally covered and packed with the largest growths of nearly every variety of timber common to this latitude. Beech may be especially mentioned which grew in great abundance in the low, flat portions of the entire valley. The heavy beech masts never failed to attract wild turkeys, pigeons, and bears, in numberless flocks and companies, every fall.'

"The wide level bottom on which Charleston now stands, was studded formerly with beech timber, and the pioneer hunters would come here every fall, from all the neighboring settlements, to kill their winter's bear meat. The bears would get so fat and lazy from eating beech mast, that they would hardly move out of the way of the hunter.

"During the summer of 1872, W. E. D. Scott visited the home of the late eminent naturalist William H. Edwards at Coalburg and made collections and studies in company with Hon. William S. Edwards the latter's son. In the 'Story of a Bird Lover,' Mr. Scott speaks of the region about Coalburg as fo'lows:

" 'The river is about a quarter of a mile wide, generally, winding in and out among the hills, which rise abruptly just back from the river, there being little bottom land. At the time I visited this region it was heavily timbered with a growth of poplar, beech, oak, and some chestnut, though beech was one of the most noticeable of the forest trees. Small streams flowed down at frequent intervals from the hills above, which form a spur of the Alleghany Range. The elevations here can hardly be called mountains, as they attain a height of not more than seven hundred feet about the level of the river.'

"There is a tract of virgin land lying on the waters of Kelly and Hughes creeks, containing 8 000 acres, on which a count of trees was recently made. This tract includes the poor land of hills, the steep bluffs of mountain streams, and the rich lands of coves and bottoms, and may be said to fair'y represent the forests of considerable of the area. The kinds and numbers of trees are as follows:

Yellow poplar	9.831 Trees
Oaks	31.710 Trees
Beech	2,497 Trees
Maple (red)	301 Trees
Chestnut	2,510 Trees

Pines	1,190 Trees
Basswood	671 Trees
Gum	509 Trees
Hickories	1,463 Trees
Ash	122 Trees
Birches	111 Trees
Sugar Maple	660 Trees
Black Walnut	62 Trees
Sycamore	5 Trees
Buckeye	3 Trees

The Lumber Industry.

"A record of the part which the forests of Kanawha County have played in the activities of its residents, from the first settlement made by William Morris in 1774 to the present day, would require a volume. Important as were the products of the forests of the county, however, affecting the financial welfare, the occupation and the very character of almost every citizen, we find only here and there a brief reference to the reduction of the forests by the early settlers, as to the development of a later lumber industry in the papers and books that contain a record of the history of this region.

"Much of the Kanawha valley was cleared and settled thickly before the timber had any considerable market value. In these days small quantities were used about the dwellings of the settlers but the amount was insignificant when compared with the enormous stand. One of the first uses made of timber, aside from that just mentioned, was in the manufacture of boxes, tubs and hogsheads in which large quantities of salt were sold from the furnaces above Charleston as early as the year 1808, and in the construction of log rafts and flat-boats on which the salt was taken down the river. Many of the receptacles and flat-boats, however, were made from timber outside the county.

"Charleston has been the center of an enormous lumber industry for many years. A report of A. M. Scott, resident U. S. engineer in charge of the river at Charleston shows the quantity of forest products that passed through Lock No. 6, four miles below Charleston, for the year ending June 30, 1892, as follows:

Timber	39,585,000 feet
Tan-bark	590 cords
Railroad ties	924.650
Hoop-poles	980,000
Shingles	2,750,000

"The report also shows that 44,400,000 feet of logs and lumber, 380,000 cross-ties, 1,405,000 oak staves and 240 cords of tan-bark came down Elk river during the same year.

"Answering a recent inquiry concerning the past lumber operations in the city of Charleston, Mr. Samuel Stephenson gives the following specific information:

"'In regard to the early operations in Charleston, Kanawha county, I desire to say that there were a great many large mills located here at one time which have long since ceased operations.

"'The Bibby mill was one of the oldest mills operated in this city. It was built a great many years ago and had a sash saw. Later a

circular saw was put in its stead. The mill was operated until a few year ago.

" 'The Woodruffs owned and operated a mill from about 1872 to 1878. This was a large circular mill capacity from 20,000 to 30,000 feet per day. The principal lumber manufactured and sawed at that time was walnut and poplar.'

" 'Manley and Frailkill had a circular saw mill, capacity 15,000 to 20,000. They operated from 1874 to 1880; walnut being the principal timber manufactured.

" 'Behymer operated a circular saw mill from 1874 to 1882.

," 'In 1882 J. R. Huffman, the inventor of the band mill, built and operated two band mills within the city. One of these mills is still standing but doing no business.

" 'The Devereaux Lumber Company owned and operated a large band mill built about 1880 and run until 1904, when it was torn down and moved to Mississippi. The mill perhaps cut more timber than any other mill that operated in the city.

" 'Since the building of the Coal and Coke railroad up the Elk river most of the mills have quit business as their log supply could not easily be maintained.

" 'These are some of the oldest mills which operated extensively from 1875 to 1905. A great deal of timber which came out of the Elk river valley, from Kanawha county and from points farther up, was rafted and floated to Gallipolis and Cincinnati where it was manufactured. The dates given in regard to these early operations may be a little off, but in the main they are correct.'

"J. H. Diss Debar, author of 'The West Virginia Hand Book and Immigrant's Guide,' published in 1870, speaks as follows of a company that operated in Charleston:

" 'A company of enterprising Pennsylvanians, with a capital of $300,000 under the corporate style of 'The Elk River Land Improvement, Manufacturing and Boom Company,' obtained a charter for the exclusive privilege of booming Elk river and its tributaries, as far up as the mouth of Holly river, and are now engaged in 80,000 acres of land in Webster and Braxton counties with saw mills, planing mills and business headquarters at Charleston.

" 'One of the first operations of this company was the shipping of 10,000 feet of black walnut plank.'

"The five band saw mills now operating in the county, except the one located on Kelly creek, are sawing timber which is obtained from other counties. A number of small lumber and stave mills are engaged in sawing in various parts of the county."

The Present Forest Conditions.

"The largest forests of the county lie in the eastern end and along the southern border. There are about 8,800 acres remaining in virgin forest and 81,000 in cut-over forest.

"Almost every acre of the Kanawha valley has been cleared, but in nearly all other parts of the county the area of woodland owned principally by farmers, approaches, equals or exceeds the area of cleared land. Jefferson, Union, Poca and Big Sandy districts have a large percentage of cleared lands, while Elk, Malden, Loudon, Washington and Cabin Creek districts have from 30 to 80 per cent. of their area in timber, or in an unimproved condition. In the coal mining sections, especially, there are large areas overgrown with unprofitable

thickets of stunted oaks, and with worthless species of shrubs and trees.

"Mr. D. G. Courtney, a prominent lumberman of Charleston, estimates that the county has about one-tenth of its original timber left, and that approximately 60 per cent. of this is oak, 20 per cent. poplar, 18 per cent. other deciduous trees, such as ash, basswood, chestnut, birch and walnut, and 2 per cent. pines and hemlock."

CARBON BLACK INDUSTRY.

The manufacture of carbon black has become quite an industry in Kanawha county. There are at present four plants engaged in this business.

It requires from **700** to **900 cubic feet** of natural gas to make **one pound of carbon black,** which usually sells from 5 to 7 cents per pound.

A brief description of each plant will now be given in alphabetic order:

Eastern Carbon Company.—This plant is located on the eastern side of Elk river at Barren creek on the Coal and Coke railroad, 26 miles northeast of Charleston, and was established in 1907. It employs seven men and has a daily capacity of 6,000 pounds, requiring from 700 to 900 cubic feet of gas to one pound of the finished product. George H. Norvill is President and A. L. Davis Vice-president and General Manager. The main office is Norwood, Mass.; Branch office, Charleston, W. Va.

Monarch Carbon Company.—This plant is located on the north side of Kanawha river, one mile east of Cedar Grove, and began shipping Carbon Black, May, 1913. The officers are J. D. Pribble, President and General Manager; M. R. Mathews, Secretary-Treasurer; main office, Charleston, W. Va. According to information given by Mr. Mathews, the plant has a capacity of 1,800 to 2,500 pounds of Carbon Black per day, requiring about 800 cubic feet of gas to one pound of the manufactured product. Employment is furnished to five men. The finished product is shipped east and west, and some of it is exported. The gas utilized is obtained from the wells of the Kanawha Valley Products Company.

Raven Carbon Company, Plant No. 1.—This plant is located in Big Sandy district at Weir P. O. on Falling Rock creek, and was established in 1912. The gas utilized is ob-

tained from the wells on the property of the Falling Rock Cannel Coal Company. The plant has a daily capacity of about 5,000 pounds. The main office is at Kane, Pa.

Raven Carbon Company, Plant No. 2.—This plant is located on south side of Elk river at Turner, 23 miles northeast of Charleston, on the Coal and Coke railway. It was established in 1913. Main office at Weir, W. Va. The gas from the company's wells is utilized, and the plant has a daily capacity of about 1,000 pounds of the finished product.

CHAPTER XIII.

SOIL SURVEY OF KANAWHA COUNTY, WEST VIRGINIA.*

By W. J. Latimer and M. W. Beck.

DESCRIPTION OF THE AREA.

Kanawha county is situated in the south-central part of West Virginia. It is bounded on the north by Jackson and Roane, on the east by Clay and Fayette, on the south by Raleigh and Boone, and on the west by Lincoln and Putnam counties. It has an area of 914.39 square miles, or 584,960 acres.

Physiographically the county lies wholly within the Appalachian Plateau. The original plateau has been severely dissected by erosion until the entire county is cut into narrow, deep, V-shaped valleys and narrow hogback ridges. The general level of the ridges ranges from 400 to 600 feet above stream level in the western part of the county to 1,000 to 1,200 feet above stream level in the eastern part. The range of elevation above sea is from 600 feet along the Kanawha river to 2,800 feet in the extreme southern part of the county. The hills over the western half of the county are more rounded and the valley walls more gently sloping than in the southeastern half, where the comparatively narrow ridge tops are supported by the massive Mahoning sandstone and the valley walls are very steep and the valleys very narrow.

The Kanawha river flows in a general northwesterly direction through the center of the county. This stream has

*Chapter XIII, giving a description of the soils of Kanawha County by W. J. Latimer and M. W. Beck is copied from the Report of the Bureau of Soils of the U. S. Department of Agriculture on Kanawha County, made in co-operation with the U. S. G. Survey and published as a separate Bulletin by the U. S. Department of Agriculture.—(I. C. W.).

a valley about a mile wide at the western edge, narrowing to about three-fourths of a mile at the eastern edge. The Elk river flows in a general southwesterly direction and joins the Kanawha river at Charleston. The valley proper of this stream is about one-half mile wide throughout its course in the county. The regional drainage is performed by these streams and their tributaries. Old river channels form a marked feature of the topography of the county. The "Flatwoods" near the Putnam county line represents the largest of these developments.

Most of the northwestern part of the county is cleared and in farms, while a large proportion of the southeastern half is still in forest, although most of it is cut over land.

The early settlements in what is now Kanawha county were made about 1780 to 1790. Settlers, mainly from Virginia and North Carolina, came into the section in large numbers during the first decade following 1800. The farming element of the county has descended from the original settlers. The more recent immigration has been caused by the growth of lumbering and coal mining. The development of the coal and oil fields in particular has brought large numbers of immigrants from the adjoining States to the north and west. Kanawha county is now one of the most densely populated counties in the State.

The development of the coal fields has increased rapidly during the last 10 years and at the present time a large percentage of the population of the county is engaged in this industry. Besides the extensive coal veins, the county is abundantly supplied with building stone and clay deposits. These have been developed to a very small extent. At one time the Kanawha salt fields produced considerable salt, but all except one of these have long been abandoned.

The Blue Creek oil field, to the north of Charleston, has been developed during the past year and gives employment to a large number of people. The development of gas has been sufficient to give Charleston a very low gas rate.

Kanawha county is well supplied with transportation facilities. It is traversed by the main line of the Chesapeake & Ohio railroad which gives connections to the east, west, and southwest. Branches of this road penetrate the coal fields.

The Kanawha & Michigan gives an outlet to the northwest and the Coal & Coke railroad to the north. Other small roads act as feeders for these main lines. Charleston is connected with St. Albans, on the south side of the river, and with Dunbar, on the north side, by trolley lines. The Kanawha river is locked and dammed through its entire course in the county and to the Ohio river, and affords a means for water transportation.

Public roads along the larger stream valleys are fairly good and a few other roads connecting the city of Charleston with other centers are kept in good condition during most of the year. Several of the old pikes constructed before the days of railroads are still in use. In general, however, the roads need improving, though, considering the broken topography of the country and the character of the road material, they are not far below the average country thoroughfares.

Charleston, the capital of the State, with a population of 22,996, is located at the confluence of the Kanawha and Elk rivers, near the center of the county, and affords a good market for produce and for securing supplies for the entire county. St. Albans with 1,209 inhabitants, and Clendenin, with 815, are other important towns.

CLIMATE.

Kanawha county has neither the rigorous winters of the North nor the intense heat that is experienced in the South during the summer, but rather a mild, equable, and healthful climate, well suited to general farming, fruit growing, and stock raising.

The mean annual temperature is 53° F., the winter mean is 34° F., and the summer mean 72° F. The highest recorded temperature in summer is 99° F. and the lowest in winter is —20°., but even such extremes are rare and of very short duration. In summer the nights are usually cool and there is little suffering from the heat. The climatic conditions prevailing during the spring and fall months are almost ideal.

The mean annual precipitation of about 43.3 inches is well distributed throughout the year, the greatest amount occurring during the growing season. Heavy floods usually come in the

early spring before crops are planted or before it is too late to replant. Damaging floods in late summer and fall are almost unknown. The snowfall is usually light and remains upon the ground for comparatively short periods. Droughts during the fall months are not uncommon. The growing season covers a period of about six months. Grazing lasts for about eight or nine months.

In the following table is given the normal, monthly, seasonal, and annual temperature and precipitation and the occurrence of killing frosts in the spring and fall as recorded at Powellton, in the adjoining county of Fayette, where the climatic conditions are much the same as in Kanawha county:

Normal Monthly, Seasonal, and Annual Temperature and Precipitation at Powellton.

Month	Temperature			Precipitation			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	34	70	— 5	3.6	0.9	3.0	4.8
January	34	74	— 5	4.1	1.8	4.4	6.1
February	33	68	—20	3.1	5.2	2.1	9.5
Winter	34			10.8	7.9	9.5	20.4
March	46	83	1	5.2	4.9	5.2	7.0
April	53	93	20	3.2	5.2	2.7	1.7
May	64	93	31	4.7	2.9	3.8	T.
Spring	55			13.1	13.0	11.7	8.7
June	70	96	42	5.3	5.2	2.8	0.0
July	73	98	46	3.5	4.6	7.6	0.0
August	72	99	42	3.8	1.9	9.6	0.0
Summer	72			12.6	11.7	20.0	0.0
September	66	99	33	2.4	1.3	1.8	0.0
October	53	92	16	1.4	1.1	3.6	T.
November	44	74	10	3.0	1.7	3.4	1.5
Fall	54			6.8	4.1	8.8	1.5
Year	53	99	—20	43.3	36.7	50.0	30.6

Average date of first killing frost in fall, Oct. 12; of last spring, Apr. 23. Date of earliest killing frost in fall, Oct. 1; of latest in spring, May 13.

AGRICULTURE.

Until within the last decade the agriculture of Kanawha county was confined to general farming and stock raising, but since then trucking and dairying have become important industries, especially in the vicinity of Charleston and St. Albans. At the present time the county may be divided into five sections, in accordance with the predominant type of agriculture.

In the eastern part of the county, around St. Albans, Coal River, and the "Flatwoods," where the Meigs soils form the upland and large areas of Holston soils are found, general farming is practiced with tobacco forming the main money crop. Very few truck crops are grown, and only a fair number of cattle are kept. Commercial fertilizers, some manure, leguminous crops, and to a limited extent cover crops turned under are depended upon to keep up the productiveness of the soil. Fruit is grown to a very small extent.

In the county around Sissonville, or the Pocatlico country, and extending across the northern part of the county, the cattle industry is extensively developed, and large areas are in blue-grass pastures. Hay is produced to some extent. No truck or tobacco is grown. Very little fertilizer is used, some stable manure is applied to the fields, a relatively small acreage is devoted to clover, and cover crops here and there turned under. In this section a practice is made of feeding cattle upon ground where hay is cut, thus returning to the soil the fertilizing elements of the crops.

In the country surrounding Charleston and upon the Kanawha river bottoms the principal forms of agriculture are truck growing and dairying. Some general farming is done, and some fruit is grown upon the ridges. The truck crops grown are potatoes, tomatoes, cabbage, cauliflower, kale, turnips, spinach, radishes, squash, cucumbers, beans, peas, sweet corn, lettuce, onions, beets, strawberries, cantaloupes, and watermelons. Fertilizers and stable manure hauled from Charleston are depended upon to maintain the productiveness of the soil.

In the country southeast of Charleston and north of the Kanawha river from Marmet to Montgomery agriculture is not very highly developed. Some general farming is practiced.

and fruit and truck crops are grown to a limited extent. A few cattle and sheep are kept.

The country south of the Kanawha river and east of Lens creek may be classed as a nonagricultural district, only widely scattered patches of corn and garden vegetables being found.

Where general farming is practiced the principal crops are corn, wheat, oats, clover, and timothy. The minor crops are sorghum, cowpeas, soy beans, redtop, millet, and Irish and sweet potatoes.

Very little improved labor-saving machinery is used except upon the river terraces and bottom lands. Fertilizers are used to a limited extent except by the tobacco growers and truckers.

There are some large commercial apple orchards in the county and nearly every farm has an orchard to supply home needs and some surplus for sale. The fruit in general is of excellent color and quality, and the trees seem to bear well. The favored varieties are: Fallawater, Ben Davis, Rome Beauty, York Imperial, Baldwin, Winesap, Jonathan, Rambo, and Russets. Peaches, cherries, pears, and plums are produced in a small way.

Tobacco growing was introduced into the county from Teays Valley; in fact, the tobacco-growing section of the county is really a portion of the Teays Valley tobacco district. Bright Burley (Lockwoods) is the variety grown. Most of the tobacco produced is of high grade. The leaf is bright and pliable and has splendid wrapping qualities. It is used largely for plug wrappers and for the manufacture of cigarette and pipe smoking tobacco. The quality of leaf varies considerably with the soil type, the condition of the land, and the quantity of manure and kind of fertilizer used. The first-bottom overflow lands produce heavy yields of tobacco of a good grade. The terrace soils produce an excellent grade of leaf, but the yield is somewhat less than on the first bottoms. The quality of hill-land tobacco varies with the condition of the fields. In some instances the quality is good, especially on newly broken land, which is very often used for this crop. The yields are not as heavy as on the bottom and terrace soils.

Corn has been grown in steadily increasing quantities since the early settlement of the county. Its production is

confined largely to the river terraces and first-bottom land. In the southeastern part of the county it is grown to some extent on the hillsides, but the yields are usually low, except upon new land. Boone County White, Reeds Yellow Dent, and Hickory King are the varieties most commonly grown. At the present time corn is planted on a larger acreage than any other of the tilled crops. Fertilizers are not used in growing corn upon the bottom-land soils, and only in small quantities where this crop is planted in the uplands. Manure is used when it can be obtained.

Wheat is grown to a very limited extent, usually upon terrace soils or flat ridge tops.

Irish potatoes are generally grown for home consumption. A few growers, located in the Kanawha Valley and upon the low hills around Charleston, produce this crop on a commercial scale. Sweet potatoes of good quality are produced to some extent upon the bottom-land soils in all parts of the county.

The grasses used in the county for the production of hay are timothy, redtop, millet, and crab grass. Hay is produced in comparatively small quantities, but large areas of blue grass are used as pasture.

Alfalfa has been successfully grown upon comparatively small areas of well-drained, well-aerated river terrace land. The majority of the upland soils are too shallow for the production of the crop. The Upshur clay contains enough lime, but the compact impervious nature of the subsoil almost precludes the profitable production of alfalfa.[1] However, clovers, soy beans, cowpeas, and vetch are legumes more or less adapted to most of the soil types in the county.

A large number of cattle are raised in the county. Most of them are shipped out when 2 or 3 years old. The few sheep kept are of the mutton variety. Hogs are found on nearly every farm. The majority of the animals are of the Berkshire and Poland-China breeds, with some Chester Whites.

A rotation of crops followed where hay is the important crop consists of winter wheat, then clover and timothy, cut for

[1]See Farmers' Bulletin 339, on Alfalfa, published by U. S. Department of Agriculture.

hay until timothy begins to run out, and then corn. If pasture is desired bluegrass instead of timothy is sown with the clover. In the tobacco districts wheat generally follows tobacco after the latter has been grown for two or three years in succession. More often than otherwise grass and clover seed are sown with wheat, but if a shorter rotation is desired, clover alone is sown, and the sod turned and the land put in corn the next year. No definite rotation is followed upon the overflow lands, and in some places corn has been planted continuously for many years.

According to the Thirteenth Census, there are 2,669 farms in Kanawha county, with an average size of 66.3 acres. Of the entire number of farms 70.1 per cent are operated by the owners and 29.3 per cent by tenants. The tenants paying cash rent are somewhat in excess of those farming on shares. Where the payment of cash rent is stipulated the rate varies considerably, being governed by location, condition of the land, etc. On the basis of shares the owner usually receives one-half the crop. In the case of tobacco he receives one-third of the crop on the bottom soils and one-fourth on upland and terrace soils.

Farm laborers are scarce, a great many men having been attracted by other industries or trades where the price paid for labor is higher. Most of the work on the farm is done by farmers and their families The average price paid for farm labor is $1 a day.

SOILS.

Exclusive of Riverwash, 14 soil types and 1 type phase were mapped in Kanawha county. These fall into three general groups, viz, upland, or residual; terrace, or old alluvial; and recent first-bottom alluvial.

The soils are grouped into series, the types in which have similar origin, color, structure, and drainage, the individual types being distinguished by differences in texture—that is, differences in the proportions of soil particles of various sizes which compose the soil.

The following outline gives the soil groups and classification according to origin and process of formation:

Group	Material from which derived.		Name.
Upland or residual.	Fine-grained sandstone and gray shale		Dekalb silt loam.
	Fine and coarse grained sandstones and shales, sandstone predominating.		Dekalb stony silt loam.
	Red and green shales, more or less calcareous, and fossiliferous limestone.		Upshur clay.
	Red and gray shales and sandstones		Meigs clay loam.
	Hard, massive sandstone		Rough, stony land.
Terrace or old alluvial.	Old terrace or Teays formation	All are derived from material washed from Dekalb soils.	Holston sandy loam.
			Holston silt loam.
			Holston silt loam, low lying phase.
	More recent low terrace.		Holston fine sandy loam.
First bottom or recent alluvial.	Derived from material washed from Dekalb and Meigs soils. Subject to poor drainage conditions.		Holly silty clay loam.
	Wash from Dekalb and Meigs soils		Huntington silt loam.
	Drainage well established		Huntington loam.
	Wash from Dekalb soils and rough, stony land		Huntington fine sandy loam.
			Huntington sandy loam.
	Wash from Upshur clay and Meigs clay loam		Moshannon silt loam.

The geological formations outcropping in the county and entering into the composition of the upland soil and subsequently influencing indirectly the character of the alluvial soils are the Monongahela, Conemaugh, Allegheny, and Pottsville formations of the Upper Carboniferous era.

The Monongahela and Conemaugh formations, consisting of alternate layers of sandstone and red shale, interbedded with a few thin strata of gray shale, limestone, sandstone, and coal seams, outcrop over the northern and western parts of the county, covering it entirely above drainage, and give rise to the Upshur and Meigs soils. The Mahoning sandstone, which is at the base of these formations, outcrops along a general northeast and southwest line through the county, entering the southern part of the county near Alum creek, passing near Charleston, and following the general course of Elk river. As the Mahoning sandstone rises to the east of the Warfield anticline, the Meigs soils cap the hills, but the "red" shales play out near the crest of this anticline, and the Conemaugh formation, found capping the hills in the southern part of the county,

gives rise to Dekalb silt loam. The formations below and including the Mahoning sandstone give rise to Dekalb soils, the flattened ridge tops and more gently sloping portions to the silt loam, and the hillsides and steeper portions to the stony silt loam.

The red shale formations are thicker in the northeastern part of the county, as evidenced by the predominance of Upshur material, and are also more calcareous. The red shale formations seem to thin toward the southeast and the sandstone to thicken, until the southern part of the county is reached, where a section would show almost entirely sandstone interbedded with thin, gray shale, sandstone, and coal seams.

In the Cabin Creek and Paint Creek region the Dekalb stony silt loam is steeper than in other sections and includes larger areas of Rough stony land and Dekalb silt loam than are found in other parts of the county or in other regions where this type has been mapped.

The Dekalb silt loam is more extensively developed in this county than in any other part of West Virginia so far surveyed. It occurs in large areas upon the crests of ridges in the southeastern part of the county. The type contains more stone and the topography is in general rougher than is characteristic of this soil in the other areas surveyed in the State.

Rough stony land is not extensively developed in the county, considering the generally rough, broken topography found here. The classification occupies only steep cliffs and rocky promontories along valley fronts.

The Upshur clay is less extensively developed than in the counties to the north, but more so than in those to the southwest. The Meigs clay loam is fairly typical.

The Holston silt loam represents old alluvium laid down when the streams of this section were flowing at a much higher level than they are at the present time and when some of them followed channels in places widely separated from their present courses. This old alluvial formation has suffered by erosion to the extent that very little of the original deposit is left. The low-terrace phase of the type is of somewhat more recent deposition, lying as second bottom along streams flowing approximately in the channels they occupy at present. The

Holston fine sandy loam is developed as sandy prominences on the low terraces.

The first-bottom soils have been classified in the Huntington, Moshannon, and Holly series. The Huntington silt loam and the Moshannon silt loam are fairly typical of these types as mapped in adjoining counties. The Huntington loam and fine sandy loam represent high bottom land subject occasionally to overflow, and a portion of the fine sandy loam probably lies above overflow. Both types are higher above stream level than the same types mapped in adjoining counties. The Huntington sandy loam being derived from material washed from the Dekalb soils and Rough stony land varies considerably in composition. In places it includes considerable Riverwash.

The Holly silty clay loam is found almost exclusively in the swales and poorly drained areas of the Kanawha river bottoms. The type is very much like the Tyler soils, and some of it lies nearly high enough to be classed as Tyler. It is subject to occasional overflow and receives a fair amount of seepage water from the adjoining hill land.

Riverwash is a classification used for the broad stream beds in the southern part of the county, where the deposits of soil have been removed during high water. It is developed to a very small extent. This is the first time that areas of this character of sufficient size to be mapped have been found in West Virginia.

The following table gives the names and extent of the several soils of the county. The distribution of these soils is shown on the accompanying map by means of colors.

Areas of Different Soils.

Soil	Acres	Per Cent	Soil	Acres	Per Cent
Dekalb stony silt loam...	219,060	37.4	Huntington silt loam...	7,890	1.3
Meigs clay loam.....	185,630	31.7	Huntington loam.....	2,652	.4
Dekalb silt loam.....	77,090	13.1	Holly silty clay loam....	1,972	.3
Holston silt loam.....	14,352	4.6	Riverwash	272	.1
Low terrace phase....	12,787		Huntington fine sandy loam	186	.1
Upshur clay.....	19,793	3.4	Holston sandy loam....	68	.1
Huntington sandy loam..	17,548	3.1	Holston fine sandy loam.	68	.1
Rough stony land.....	17,480	3.0			
Moshannon silt loam.....	8,162	1.3	Total	584,960	100.0

Dekalb Silt Loam.

The Dekalb silt loam consists of a gray, grayish-yellow, or pale-yellow silt loam, underlain at an average depth of about 10 inches by a yellow, friable, silty clay loam, which either continues downward through the 3-foot section or passes into a yellow, crumbly, silty clay near its lower limit. In places the sub-soil is faintly mottled in the lower part with red or shades of brown. In the poorer drained, flat bodies here and there the surface is more distinctly gray and the subsoil is generally mottled slightly with gray. Occasionally bedrock comes within the 3-foot section. Usually the material directly over the rock is more sandy than that at a greater distance above, which accounts for the sandy character of some of the sloping areas where erosion has removed a portion of the top material, thus bringing the underlying rock nearer the surface. There are some patches on the slopes which really represent Dekalb sandy loam, these not having been mapped on account of their small size and irregular distribution. Small fragments of sandstone frequently occur on the surface and throughout the typical smooth, less sloping portions of the type, while on slopes a good many fragments, some small and some moderately large, are present.

The Dekalb silt loam occurs to a large extent upon the crests of the mountain ridges and is developed over the southeastern half of the county. The soil material is derived from shales and sandstones belonging to the Charleston and Allegheny formations. The surface configuration is undulating to gently rolling and sloping. Much of the type is timbered with oak, chestnut, and some dogwood, pine, and sourwood.

A considerable proportion of the type is under cultivation to the general farm crops, including wheat, oats, rye, corn, potatoes, timothy, redtop, clover, cowpeas, and soy beans. Owing largely to the fairly even surface, on which reapers can be used, wheat is a crop of some importance. The yields vary from 10 to 20 bushels per acre, the best results being on portions of the type that have been built up by turning under organic matter. Oats and rye are grown very little. The yields are comparatively low. Corn does only fairly well, the yields rarely exceeding 25 bushels per acre, unless stable

manure and heavy applications of nitrogenous fertilizer are used. Cultivated grasses do fairly well, but this soil is not especially adapted to blue grass. Clovers do not thrive upon this soil as upon those that contain more lime. The type is very well suited to Irish potatoes, and there is an excellent local market for this crop. (Pl. I, fig. 1.) The yields vary from about 100 to 250 bushels per acre. The soil responds well to commercial fertilizers, and in the illustration cited above the rows on the left have been fertilized, those on the right have not.

The Dekalb silt loam is well adapted to the growing of apples, peaches, pears, plums, blackberries, raspberries, strawberries, and other small fruits. The topography and position of the type make it well suited to commercial orcharding, and many good orchards are located upon it.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silt loam:

Mechanical Analyses of Dekalb Silt Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221019	2 miles south of Spring Hill.	Silt loam, 0 to 8 inches	0.5	1.4	1.0	5.5	13.8	63.8	13.7
221020	Subsoil of 221019...	Silty clay loam 8 to 36 inches	.3	.8	.8	4.1	12.8	60.4	20.9

Dekalb Stony Silt Loam.

The soil material of the Dekalb stony silt loam is essentially identical with that of the Dekalb silt loam, but there is a wide difference in topography, as well as in the quantity of rock fragments present. The fine material consists generally of a gray, pale-yellow or dark-gray silt loam, underlain at variable depths, usually at about 8 to 10 inches, by yellow silty

clay loam, which in places passes below into yellow silty clay. Bedrock is frequently reached within the 3-foot section. Small and large fragments of sandstone and, to a less extent, of shale are scattered over the surface and disseminated through the soil body in varying quantities. The type includes areas having the texture of a loam and some even as light as a sandy loam, but these were not mapped on account of their small size, irregular distribution, and inaccessibleness. There are also many patches in which the surface soil is a dark-gray to black mellow loam to a depth of about 3 to 6 inches. The black color of these areas, which occur in the shelf situations upon the gentler slopes and in the mountain-side drainage ways or coves, is due to the presence of a large amount of decomposing vegetable matter derived from the mantle of leaf mold. There are places where a part of the dark color is caused by coal particles from "coal blossoms" and wash from numerous coal seams that outcrop upon the mountain sides of the Allegheny and Pottsville formations. Where fields of this soil have been cleared and put under cultivation, years of constant cropping, even to the point where poor yields are obtained, does not seem to change the color of the soil to any appreciable extent.

The Dekalb stony silt loam characteristically occurs on steep slopes, frequently flanking the high, relatively flat-topped ridges occupied by the Dekalb silt loam. These slopes are generally so steep as to be difficult to climb. The fact that such steep slopes are soil clad rather than bare rock outcrop or rough, rocky land is surprising. There are some included areas of both Rough stony land and Rock outcrop, the last often occurring as sheer rock cliffs, but these could not in all cases be satisfactorily mapped. The heavy tree growth, including chestnut, oak, dogwood, poplar, and spruce pine has assisted in holding the soil in place against erosion.

Most of this type is forested; in fact the greater part of it is suitable for nothing else except pasturage, and some of it is so steep that severe grazing would be followed by ruinous washing. Some of the less sloping portions, such as part of that in the vicinity of Charleston, are used for corn, truck crops, hay, and pasturage. Cultivation of many of the slopes with plows is absolutely out of the question; the land would even be difficult to cultivate by hand.

In the vicinity of Charleston where land values are high and large quantities of stable manure can be secured, the type can be profitably used for the growing of truck crops and sweet corn, provided this work is done largely by hand. The type is fairly well adapted to fruit, but the steepness of the slope precludes commercial orcharding.

The yield of corn is usually very low, averaging around 10 bushels per acre, except on newly-broken land, where it will range from 25 to 30 bushels. The soil is not especially adapted to grasses or clovers. Tobacco can be grown to advantage on the gentler slopes. In general the type is not desirable for farming and probably would be more profitably kept in forest.

Upshur Clay.

The Upshur clay typically consists of an Indian-red, heavy, somewhat plastic clay having a depth of 3 feet or more. There is a thin surface mantle over most of the type varying from a fraction of an inch to 3 or 4 inches in thickness and consisting of dark-brown to reddish-brown or Indian-red silt loam to silty clay loam. Fragments of red and greenish shale and sandstone are present in varying quantities upon the surface and throughout the profile in most of the type. In places lime concretions are found in varying quantities. These are derived from associated fossiliferous limestone or red shaly limestone formations. The most noticeable occurrence is the Ames limestone horizon, which outcrops in the southwestern part of the county and is very conspicuous in the hills south of St. Albans.

In topography the type varies considerably, the surface depending upon the position of outcropping strata of the parent shale rock. Areas are found upon ridge tops, upon benches, and at the base of hills. In general the surface configuration is gently rolling, but there are places where it is comparatively steep. The type is developed over the northwestern part of the county and occurs usually in comparatively small areas. The largest bodies are in the extreme northwestern corner of the county to the north of Pocatalico river. Nearly all of the type is cleared and under civilization. It is considered the strongest upland soil in the county and is best

suited to general farming. It is well adapted to grasses and clover. Bluegrass comes in naturally, and where sown it makes a splendid stand and pastures last indefinitely.

The crops grown are corn, wheat, oats, clover, and timothy. Wheat yields from 12 to 20 bushels per acre. Probably one-half of the wheat grown in the county is upon this type. Corn produces well where the soil has been properly handled, yielding from 25 to 40 bushels per acre. Oats are grown to a very small extent and yield from 20 to 30 bushels per acre. Clover is grown alone upon this soil more than on any other type in the county. It seeds readily and yields from 1 to 2 tons of hay per acre. Timothy makes a good growth and yields from 1½ to 2½ tons of hay per acre. A mixture of clover and timothy probably gives the best results. Tobacco is grown on a relatively small area. About 1,000 pounds per acre is the average yield where proper fertilization and cultivation are given, but the quality of leaf is not so good as upon the Dekalb soils.

This soil is not especially well adapted to fruits. It can not be recommended as a truck soil, although where the seed bed is properly prepared heavy yields of garden crops can be obtained.

The type originally supported a heavy growth of oak, hickory, walnut, ash, poplar, maple, and beech.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

Mechanical Analyses of Upshur Clay.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221017	2 miles south of Hill.	Brown clay, 0 to 8 inches	0.0	1.4	1.1	3.2	4.0	58.8	31.3
221018	Subsoil of 221017...	Red clay, 8 to 36 inches	.0	.0	.3	.9	2.0	39.4	57.0

Meigs Clay Loam.

The Meigs clay loam consists of undifferentiated Dekalb and Upshur material resulting from the weathering of comparatively thin strata of sandstone and red shale with occasional beds of gray shale and fossiliferous limestone. The sandstone and gray shales weather into Dekalb silt loam, and the red shales mainly into Upshur clay. There is present gradational material between the Upshur and Dekalb, as upon the steep hillsides where mixing of material derived from the different rocks is caused by landslides and surface wash. Such Upshur-Dekalb soil is gray to reddish-gray upon the surface and varies from silt loam to silty clay loam in texture. The soil varies from 2 to 8 inches in depth. The subsoil is a yellow to reddish-yellow silty clay loam, grading at about 2 feet into a dull-red or mottled Indian-red and yellow clay.

The prevailing color characteristics of the Meigs clay loam are gray and yellow in the soil and red or yellowish red in the subsoil. Scattered upon the surface and also through the entire soil profile is found a considerable quantity of small shale and sandstone fragments, but not enough to give the soil a gravelly character, except locally. In many places a mass of rock fragments or the parent rock is encountered at 24 to 36 inches, but over the greater proportion of the land the soil material is 3 feet or more deep.

The proportion of Upshur to Dekalb material varies considerably in different places. The Upshur is dominant in the northwestern part of the county and the Dekalb becomes more pronounced toward the eastern boundary of the type where the red shale formation begins to thin and finally disappears before the southern part of the county is reached. The proportions of the Upshur and Dekalb soils composing the Meigs type vary in different places owing to the predominance of the shale or sandstone parent rock.

The Meigs clay loam is confined almost entirely to the northwestern half of the county, touching the area near Olcott and running in a general northeasterly direction, passing to the east of Charleston, then turning and passing out of the area near where Spruce Fork of Blue creek crosses the county

line. It is one of the most extensively developed soils in the area.

Over most of its area, the topography of the Meigs clay loam is steep. (Pl. I, fig. 2, Pl. II, figs. 1 and 2.) In some places the ridges broaden out, the hills are more rounded, and the slopes are more gentle. Benches, or "shoulders," are of frequent occurrence on the slopes, owing to uneven weathering of the hard sandstone and soft shale. Such benches are nearly level. On the whole the grainage of this soil is excessive and during dry spells crops often suffer for lack of moisture.

On account of the large proportion of included heavy Upshur material cultivation is difficult over much of the Meigs clay loam area, and plowing must be done when the soil is only moderately moist in order to avoid clodding.

The principal crops grown are corn, wheat, tobacco, and hay. Corn yields from 15 to 35 bushels, with an average of 25 bushels per acre, and wheat from 10 to 20 bushels per acre. The best yields are obtained usually upon ridge tops or where the soil is predominantly Upshur. For wheat 250 to 300 pounds of acid phosphate are used upon this type, a little heavier application being made when grass is to follow the wheat. Tobacco is not grown as extensively on the Meigs clay loam as in adjoining areas, but produces from 1,000 to 1,200 pounds per acre. It is generally grown on new land, and when old land is used heavy applications of fertilizer are made. Grass does well, and much of the land is in permanent blue grass pastures. The grazing capacity of the land in general is placed at about 1 steer per acre and slightly higher where the Upshur clay is dominant. Timothy and redtop are grown for hay and yield about 1 to 1½ tons per acre, but the surface is usually too steep for the use of mowers, so that hay production is not carried on extensively. A good stand of blue grass well cared for will last for 15 to 20 years without resodding, and if judiciously grazed and limed the life of sod can be prolonged indefinitely. The Upshur material is fairly well adapted to clover.

A large number of beef cattle and some sheep are kept. Where the land is located near Charleston and large quantities

of stable manure can be obtained, truck crops can be grown to advantage.

Fruits do well, especially upon the Dekalb material. A few good orchards were seen. These were producing an abundance of fruit of excellent quality. Apples, peaches, plums, and cherries were found flourishing in small orchards.

Most of the Meigs clay loam is cleared and in pasture or in cultivated crops. The natural forest growth consists largely of oak, chestnut, chestnut oak, hickory, walnut, and locust.

The price of land composed of Meigs clay loam varies from $15 to $50 an acre.

Rough Stony Land.

The Rough stony land includes areas so steep or so covered with rocks, or both, that it is impossible to cultivate them. A few areas of Rock outcrop too small to separate have been mapped along with this type. The topography is usually very steep, the land occurring for the most part along the valley walls of the larger streams. The soil material is for the most part similar to that of the Dekalb silt loam, although there are included areas having the texture of the clay loam member of this series.

Rough stony land is of little or no agricultural value. Portions of it can be grazed, but by far the greater part can be best utilized for forestry. The natural tree growth consists largely of oak, spruce pine, and hemlock.

Holston Silt Loam.

The surface soil of the Holston silt loam is a brown to yellowish-brown, mellow, silt loam about 10 inches deep. The subsoil is a yellowish-brown, friable, heavy silt loam to silty clay loam, becoming more compact with depth.

The material of which this soil is formed is old alluvium washed from the various upland soils of the region, mainly those derived from sandstone and shale. The type occurs as high second bottoms, stream terraces, or old abandoned stream channels. It stands several hundred feet above the first bottoms of associated streams. The most prominent area is

found in what is known as the "flatwoods," a section of the county lying north of St. Albans near the Putnam county line. The flatwoods seems to have the general elevation and other features characterizing Teays Valley. The type is also found in detached areas in different parts of the county. The old alluvial deposits have suffered considerably by erosion and the remnants represented by the Holston silt loam form only a small proportion of their original area. The deposits are scarcely ever deeper than 25 to 30 feet.

The crops grown on the Holston silt loam are wheat, oats, corn, timothy, clover, tobacco, and potatoes, and other vegetables. Buckwheat is occasionally grown as a catch crop. Plate I, figure 2, shows a good stand of this crop. Wheat yields from 15 to 25 bushels, oats from 20 to 30 bushels, corn from 20 to 25 bushels, and timothy about 1½ tons per acre. Clover does fairly well, but is not so well adapted to the type as cowpeas, soy beans, or vetch. (Pl. II, fig. 1.) Potatoes are grown on a small acreage, the yields ranging from 100 to 200 bushels per acre. The soil is especially adapted to this crop, and much better yields can be obtained by modern methods of culture.

While the yields of tobacco upon the Holston silt loam are not quite so heavy as upon the first bottom soils, averaging about 1,000 pounds per acre, the leaf is of high grade.

As a result of lax methods of cultivation the productiveness on many areas of this soil has declined, but where it has been properly farmed the yields are very satisfactory. It is easily cultivated and can be handled without danger of baking or hardening, even if only small quantities of organic matter are incorporated with it. (Pl. II, fig. 2.)

Holston Silt Loam, Low-terrace Phase.—The surface soil of the low-terrace phase of the Holston silt loam is practically identical with the typical soil, except in color, which is slightly darker. The subsoil is about the same color, but is slightly heavier and more compact than the typical subsoil. The phase is found along the bottoms of the Kanawha river and large tributary streams, where it lies from 50 to 75 feet above stream level, or just above overflow. It represents a terrace of the present streams and is of more recent formation than the soil of Teays Valley. The topography is much more nearly level and the surface has suffered very little from erosion.

The low-terrace phase is a better agricultural soil than the rest of the type, but the generally better yields secured on it are in a measure the result of the better farm practice obtaining in the country along the larger river bottoms than in regions more remote.

Early and late potatoes, cabbage, beans, peas, and tomatoes are truck crops that are grown to advantage on the low terrace phase of the Holston silt loam.

The phase is situated too low for profitable commercial orcharding, but small fruits do well and should be more extensively grown.

The type in general is practically all cleared and under cultivation. The natural forest growth consists of white oak, elm, poplar, sycamore, and beech, and thus is seen to be more closely related to the bottom land than the upland soils.

Land of this low terrace phase is valued at $100 to $150 an acre, while the prices asked for the rest of the type range from about $30 to $75 an acre. The location of the two soils has much to do with this wide difference in value.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Holston silt loam:

Mechanical Analyses of Holston Silt Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221033	0.5 mile south of St. Albans.	Silt loam, 0 to 8 inches	0.0	1.8	1.4	5.4	19.8	55.4	16.3
221034	Subsoil of 221033...	Heavy silt loam, 8 to 36 inches.....	.5	1.6	1.1	6.5	21.3	48.2	20.7

Holston Sandy Loam.

The Holston sandy loam is developed to a very small extent, occurring only at one place, near Spring Hill, in an area large enough to map. Smaller areas are scattered through

the Holston silt loam. The type consists of a brown sandy loam, underlain at 8 to 10 inches by pale-yellow loamy sand or sandy loam, which at about 2 feet grades into yellowish-brown or reddish-yellow sandy loam to sandy clay. A considerable number of cobbles and small bowlders are found in the lower part of the sandier areas.

The type at the present time is used for pasture, and for corn and garden crops. It does not furnish very good grazing, as broom sedge seems to be the dominant growth in abandoned fields. The type is well adapted to vegetables and could be used advantageously for early truck crops, such as radishes, kale, beets, lettuce, etc. Melons and cucumbers do well and could be grown profitably, as could also Irish and sweet potatoes. It is also well adapted to cowpeas, soy beans, and vetch.

While the Holston sandy loam is not quite so productive as the Holston silt loam, it is better adapted to early truck crops, and for that reason, being situated near the important local market at Charleston, should be more valuable.

Holston Fine Sandy Loam.

The Holston fine sandy loam consists of a brown loamy fine sand to fine sandy loam, underlain at about 10 to 12 inches by a yellowish-brown, friable, light, fine sandy loam or loamy fine sand, only slightly compact even in the deeper subsoil. The type occupies swells on very slight elevations in the Holston silt loam, low terrace phase, near Institute.

The soil has about the same agricultural value as the Holston silt loam, with the exception that it is easier to work and better adapted to early vegetables and melons. At the present time it is utilized for general farm crops. Peas, soy beans, and vetch do exceptionally well. The soil is adapted to about the same crops as the Holston sandy loam, but is slightly more productive.

Holly Silty Clay Loam.

The Holly silty clay loam consists of a gray or drab heavy silt loam to silty clay loam, friable and slightly compact, underlain at about 8 to 10 inches by a mottled gray or drab,

yellow, and in some places reddish-brown silty clay. The subsoil is moderately plastic and has greasy feel, owing to the presence of fine particles of mica. In places the immediate surface portion is of a brownish color and in other low, poorly drained spots where organic matter has collected the surface for a few inches is black, but the subsoil is always light colored and mottled.

This type is confined almost entirely to the Kanawha river bottoms and occupies poorly drained depressions and swales, which, in part at least, are subject to overflow. The compact, intractible structure of the subsoil is one factor impairing the drainage. This soil is known locally as "crawfish land" and in nearly all cases shows an acid reaction.

This soil can not be plowed while in a wet condition, as clodding results. Heavy rollers are required to pulverize the soil when clods have been formed. Upon drying out the soil bakes hard and deep cracks form in the surface.

In its present condition the Holly silty clay loam is best adapted to pasturage and the production of hay. When drained and properly handled fair to good yields of nearly all the crops grown in the county may be secured. Hay yields from 1 to 1½ tons per acre.

The original forest growth of beech, sycamore, willow, and elm has been cleared away and most of the type is in pasture.

The results of mechanical analyses of samples of the soil and subsoil of the Holly silty clay loam are given in the following table:

Mechanical Analyses of Holly Silty Clay Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221005	Dunbar	Silt loam, 0 to 10 inches.	0.3	2.1	1.5	8.2	14.3	55.6	22.6
221006	Subsoil of 221005...	Silty clay loam, 10 to 36 inches.	.0	1.9	1.4	2.6	13.6	56.1	24.3
221009	1 mile east of St. Albans	Silt loam, 0 to 8 inches.	.2	1.2	3.0	5.6	9.9	49.6	30.7
221010	Subsoil of 221009...	Silty clay loam, 8 to 36 inches.	.2	1.4	3.0	5.0	8.5	46.5	35.6

Huntington Silt Loam.

The Huntington silt loam is a mellow, brown silt loam, underlain at varying depths, usually about 12 inches, by somewhat lighter colored, friable silt loam. The texture varies somewhat in both the surface and subsoil portions, but is generally that of a typical silt loam. Sandstone and shale fragments are common in the narrow bottoms, especially near the heads of streams and at the junction of streams entering the river from the adjacent uplands. The type as developed along the Kanawha river is dark brown in color and contains very few, if any, rock fragments. Here, also, it occurs in comparatively large bodies and represents the best development of the type.

The material is derived from wash from the upland soils of the drainage basins of the streams along which the type occurs, chiefly from the Dekalb soils.

The Huntington silt loam is a productive type and is so recognized by the farmers of the county. The leading crops are corn, wheat, oats, sorghum, clover, timothy, and potatoes and other vegetables. Of these the soil is probably best adapted to corn, and a large area is devoted to this crop each year. The yields vary from 50 to 70 bushels per acre without the use of fertilizer, stable manure, or green manuring crops. The constant enrichment of the soil by sediments laid down by floods makes such yields possible without artificial fertilization. Wheat, oats, and clover are usually grown upon the higher portions of the bottom that are subject to only occasional overflow. The yields of both wheat and oats are good, but there is a tendency for such crops to lodge, and much loss may be sustained in this way, especially if hard wind storms immediately precede harvest. Timothy does exceptionally well, and heavy cuttings are obtained from meadows of this grass, the yield ranging from 2 to 2½ tons of hay per acre. Cowpeas, vetch, alsike clover, redtop, and tall meadow oat grass do well, but are grown to a very small extent. A large proportion of the sorghum produced in the county is grown upon this type, the average yield of sirup being from 40 to 60 gallons per acre. The lower portions of the bottoms are well suited to grasses and much of the type is used for grazing, as it furnishes good

pasture when the hill pastures are suffering from drought.

In general the Huntington silt loam, like other bottom land soils, is too low for the profitable production of orchard fruits. Heavy yields of a fairly good grade of Burley tobacco are secured, the average being about 1,200 pounds per acre. This is produced usually with the application of relatively small quantities of commercial fertilizer or manure.

The type is subject to spring overflow, and if cultivated while too wet serious clodding results. Little of this type is in an acid condition.

Nearly all the Huntington silt loam is cleared and under cultivation. The original forest growth consists mainly of sycamore, elm, birch, beech, willow, and gum.

The price of the Huntington silt loam ranges from $50 to $150 an acre.

Huntington Loam.

The Huntington loam, as typically developed, is a dark-brown, mellow, light loam, underlain at about 15 inches by a friable brown loam, only slightly compact. In places, usually immediately along the river bank, the texture is nearly that of a fine sandy loam. Back from the river it is considerably heavier, approaching a silt loam. Much of this soil, like the Huntington fine sandy loam, lies either above overflow or above all floods except those of exceptional severity. A considerable proportion forms the front lands of the Kanawha river at a natural levee. The remainder mostly occurs at very nearly the same level, but at some distance from the river banks, from which it is separated by lower land or swales occupied by the Holly silty clay loam. The topography is nearly level to gently sloping or slightly undulating.

Agriculturally the Huntington loam is probably the most valuable soil in the county. The ease with which it can be cultivated, its productiveness, and its wide range in adaptation make it one of the most desirable soils in this section of the country. The crops grown are corn, wheat, oats, timothy, clover, tobacco, sorghum, millet, melons, potatoes, and truck, including nearly all the vegetables suited to the climate of the region. Although the soil is subject to only occasional over-

flow, very little fertilizer or stable manure is used, except where tobacco or truck crops are to be grown. A crop of clover or rye is occasionally turned under to help maintain the supply of organic matter.

This type is well suited to legumes, such as cowpeas, soy beans, vetch, and alfalfa. The cowpea is the only one of these crops that is planted to any considerable extent. Corn yields from 50 to 60 bushels and tobacco about 1,200 pounds per acre. Wheat, oats, and rye give good returns, but considerable loss is occasioned by lodging.

All of the type is cleared and under cultivation. Birch, beech, elm, sycamore, and willow seem to have been the prevailing forest growth. The price of land is usually high, owing to its location in relation to transportation facilities and markets, ranging from $100 to $300 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Huntington loam:

Mechanical Analyses of Huntington Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221011	1 mile east of St. Albans	Loam, 0 to 10 inches	0.2	0.8	2.2	23.8	25.6	33.0	15.2
221012	Subsoil of 221011	Light loam, 10 to 36 inches.	.0	.4	1.6	25.3	27.7	29.0	15.9
221013	1 mile east of St. Albans	Loam, 0 to 10 inches	.0	.4	.5	2.6	13.4	57.6	25.4
221014	Subsoil of 221013	Silty clay loam, 10 to 36 inches.	.1	.3	.4	1.6	15.7	49.1	32.9

Huntington Fine Sandy Loam.

The Huntington fine sandy loam consists of a brown loamy fine sand, underlain at about 10 to 15 inches by light-brown or yellowish-brown loamy fine sand, which grades below into moderately heavy, friable fine sandy loam.

This type is confined to the rather high bottom of the Kanawha river, where overflows seldom, if ever, occur. It is

the best trucking soil in the county and considerable areas are used for that purpose. Turnips, lettuce, onions, radishes, spring kale, potatoes, cabbage, beans, peas, tomatoes, sweet corn, and cantaloupes are the principal crops of this sort. Corn, as a field crop, is grown to a very limited extent. Timothy does only fairly well. About 2 tons per acre of crab-grass hay is cut after the truck crops are gathered.

Practically all the leguminous crops, alfalfa included, should do well upon this type. Wheat, oats, and rye are grown only to a small extent, but make excellent yields when properly fertilized.

The truckers upon this type use rather heavy applications of stable manure, about ten 2-horse wagon loads per acre. Commercial fertilizer is also used; about 600 pounds of an 8-5-8 formula for most vegetables and the same quantity of a 8-6-8 brand for potatoes.

Land of this type ranges in value from $100 to $250 an acre.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the Huntington fine sandy loam.

Mechanical Analyses of Huntington Fine Sandy Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221027	1 mile west of Montgomery	Fine sandy loam, 0 to 15 inches.	0.0	0.5	2.0	42.5	28.4	16.9	9.6
221028	Subsoil of 221027...	Fine sandy loam, 15 to 36 inches.	.0	.5	4.0	43.9	30.1	12.5	8.9

Huntington Sandy Loam.

The surface soil of the Huntington sandy loam is a dark yellowish-brown, more or less incoherent, light sandy loam, 10 to 12 inches deep. This grades into a sandy loam of slightly lighter color and slightly heavier texture. In most places con-

siderable sandstone and shale fragments are found scattered upon the surface and throughout the soil section. There are included spots of gravel and also of sand too small to map separately. Some of those are really Riverwash.

The material forming this type is derived from the wash of the Dekalb soils and is developed along the streams in the southeastern half of the county. The topography is level to undulating. The surface varies considerably in elevation above stream level, but practically all the area of this soil is subject to occasional inundation. At other times the type is usually well drained.

The Huntington sandy loam is a friable, easily cultivated type well suited to the production of early truck crops, sweet and Irish potatoes, melons, sorghum, corn, peas, soy beans, and vetch. Irish potatoes yield from 150 to 250 bushels per acre, and sweet potatoes a little more than this.

The results of mechanical analyses of typical samples of the soil and subsoil of the Huntington sandy loam appear in the following table:

Mechanical Analyses of Huntington Sandy Loam.

No.	Locality.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay.
			P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*
221025	1 mile east of Barlow	Sandy loam, 0 to 10 inches	0.9	12.2	17.6	29.9	17.1	15.6	6.8
221026	Subsoil of 221025...	Sandy loam, 10 to 36 inches.	.4	12.8	18.6	26.9	16.3	16.4	8.4

Moshannon Silt Loam.

The Moshannon silt loam is a chocolate-brown silt loam, underlain at about 6 to 10 inches by a chocolate-red or Indian-red silty clay loam to silty clay. The subsoil is friable, although it becomes slightly compact in the lower portion. Both soil and subsoil contain a considerable number of sandstone and shale fragments, and in many places beds of this

material are encountered at from 30 to 36 inches or more below the surface.

The type is found largely developed along the streams in the northwestern corner of the county, in whose drainage basins the red shale formations cover considerable areas.

It occurs as first-bottom overflow land, and the material from which it is derived has been washed from areas of the Upshur clay or of Meigs clay loam in which the Upshur material is dominant. The red color of the alluvial type is caused by the admixture of Upshur material.

The topography is level to gently sloping and the drainage is good over most of the type. The soil is very productive, giving excellent yields of corn, wheat, oats, tobacco, sorghum, potatoes, hay, and clover. Corn yields from 50 to 80 bushels per acre. Wheat and oats have a tendency to lodge but are grown successfully upon the higher lying areas of the type, 12 to 15 bushels being considered a good yield. A yield of 1 to 2 tons of timothy hay per acre is usually obtained. Grass does well and much of the type is in pasture. Tobacco is grown to a small extent, with an average yield of about 1,000 to 1,200 pounds per acre, usually of a rather strong, thick leaf. Sorghum makes a heavy growth and produces about 75 gallons of sirup per acre.

Nearly all the type is cleared and under cultivation. The native forest growth consisted largely of elm, sycamore, birch, beech, sweet gum, and willow.

Land composed of the Moshannon silt loam is valued at $50 to $100 an acre.

Riverwash.

Riverwash includes narrow strips of water-rounded cobbles and angular fragments of sandstone, mixed with considerable sandstone and shale gravel and some fine soil material. It occurs along streams, much of it in the rather broad channels of those streams which carry a large volume of water for brief periods during and immediately following heavy downpours. The type is confined to the comparatively narrow, deep valleys in the eastern part of the county where the run-off is very rapid. A few strips of silt loam, gravelly loam, sandy

loam, and loam too small to separate are included with the Riverwash. These better patches are used as gardens and have about the same value as the Huntington types of corresponding textures. Aside from these patches the type has little or no agricultural value.

SUMMARY.

Kanawha county lies in the south-central part of West Virginia and has an area of 914 square miles, or 584,960 acres.

It includes a part of the severely dissected portion of the Appalachian Plateau and has in general rough and broken topography.

The Kanawha river receives the entire drainage of the county. A large percentage of the population is engaged in other pursuits than farming, principally in coal mining.

Charleston, the capital of the State, is the largest town and the principal market in the county.

Good transportation facilities, both rail and water, are afforded.

The climate is mild and equable, the temperature rarely rising above 100° F. or falling below zero. The growing season covers a period of 6 months.

Agriculturally the county may be divided into five districts, based upon differences in practices and crops grown, viz, (1) St. Albans district, where tobacco forms the main money crop; (2) Pocatalico district, where stock growing is the leading industry; (3) Charleston district, where trucking and dairying lead; (4) Putney and Blakeley districts, where general agriculture is practiced to a small extent and no one line is largely developed; (5) Cabin Creek-Paint Creek district, where little or no agriculture is practiced.

The general crops grown are corn, wheat, oats, millet, sorghum, cowpeas, potatoes, clover, timothy, and the truck crops.

Large numbers of beef cattle are raised and also a few sheep for mutton. Hogs and poultry are found in all parts of the county, usually in small numbers.

Apples are grown only on a small scale commercially, and other fruits almost exclusively for home consumption.

Labor is scarce and most of the farm work is done by the farmer and his family.

The soils fall into three groups: Residual, or upland soils; terrace, or old alluvial soils; and first bottom, or recent alluvial soils.

Exclusive of Riverwash, 14 soil types and 1 phase were mapped. They range from sandy loam to clay in texture.

The rocks giving residual soils belong to the Carboniferous period. They are mainly shales and sandstones.

The Dekalb silt loam, with gray soil and yellow subsoil, is more extensively developed in Kanawha county than in any other part of West Virginia so far surveyed. It is used for general farming, trucking, and fruit growing.

The Dekalb stony silt loam has a steep, broken topography and is unfit for extensive agricultural development.

Rough stony land is developed to a limited extent, considering the rough character of much of the country. It is essentially non-agricultural.

The Upshur clay is developed in the western part of the county. It is suited to grazing and to the production of wheat, clover, and timothy.

The Meigs clay loam occupies extensive areas in the northwestern and north-central portions of the county. It is well adapted to grass, and makes good pasture land.

Scattered areas of Holston silt loam occur in this county. It is best suited to the production of tobacco, potatoes, and truck crops. The low terrace phase is a more productive soil than the typical soil and adapted to a much wider range of crops.

Only small areas of the Holston sandy loam and fine sandy loam are found and they are not important soil types. They are adapted to early, light truck crops.

The Holly silty clay loam usually occurs as high-bottom land along the Kanawha river. It is only occasionally overflowed, but is affected by seepage water during most of the year. Owing to poor drainage, it is a difficult soil to handle and is best suited to grass.

The Moshannon silt loam is well adapted to corn, tobacco, and grass.

The Huntington silt loam and loam are dark-brown to

yellowish-brown soils. They are best adapted to corn, tobacco, and truck crops. The loam is confined to a narrow strip along the Kanawha river banks.

The Huntington sandy loam and fine sandy loam are the best types in the county for truck growing, and considerable areas of the latter are used for that purpose.

PART IV.

Paleontology.

CHAPTER XIV.

NOTES ON THE PALEONTOLOGY OF KANAWHA COUNTY.

By W. ARMSTRONG PRICE*.

SCOPE OF THE INVESTIGATION.

The following report on the paleontology of Kanawha county contains a brief description of the stratigraphic horizons in the county which are known to contain marine fossils, together with a description of the species which were collected at one locality from the Kanawha Black Flint, and plates illustrating the fossils described.

The work of which the following pages is the result was done on short trips during the fall and winter of 1913, and serves merely to outline the more detailed work which the writer expects to do in the future, with a view to a complete knowledge of the paleontology of Kanawha county.

*The writer wishes to express his thanks to Dr. George H. Girty, of the U. S. Geological Survey, for the use of his collections for comparison with the Kanawha Black Flint fossils, and for his generous advice in questions of doubt; to Miss Frances Wieser for the illustrations which accompany the description of species; and to Dr. I. C. White, and Messrs. Krebs, and Teets for the location of the collections, which they discovered in the course of field work.

FAUNAL HORIZONS.

The geological horizons in Kanawha county which are now known to contain marine invertebrate fossils, with their stratigraphic positions, are given in the following table*:

	Thickness. Min. Ft.		Max. Ft.	Total. Ft.
1. Sandstone, Homewood	40	to	60	60
2. Shales, sometimes holding coal	0	"	20	80
3. **Kanawha Black Flint,** marine fossils.	0	"	10	90
4. Interval			269	359
5. **Limestone, Winifrede,** impure, marine fossils	½	"	1	360
6. Interval			176	536
7. **Limestone, Dingess,** silicious, lenticular, ferriferous, marine fossils	0	"	2	538
8. Interval			495	1033
9. **Limestone, Eagle,** dark gray, hard, marine fossils	1	"	2	1035
10. **Shale, Eagle,** dark, marine fossils	1	"	5	1040
11. Interval, to base of Kanawha (Upper Pottsville) Series, and top of Nuttall sandstone	150	"	200	1240

Kanawha Black Flint.

Queen Shoals.—The writer has examined this horizon for fossils only at this locality. At this town, in Big Sandy district, Kanawha county, 0.3 miles south of Elk River on Queen Shoals creek, just above the mouth of Left Fork, in the cut of a mine railroad much of the platy flint has lain exposed to the weathering of the atmosphere for some time, making it more fissile and easier to collect from. In a cut of the same mine railroad where it joins the tracks of the Coal and Coke R. R. just east of the station at Queen Shoals and 200 yards from the county line, in Clay county, the flint is less well exposed, but yielded a few good specimens. A large collection was made at these localities, with the assistance of Mr. D. D. Teets,

*Ray V. Hennen, General section Kanawha Series, see introduction by I. C. White.

to whom the writer is indebted for his knowledge of the locality as well as for aid in collecting. The following section was obtained in this vicinity:

	Feet.
1. No. 5 Block coal.....	
2. Interval[1] (containing Homewood sandstone in lower portion; base concealed by sandstone rubble).....	196
3. Sandstone, even-grained, yellow.....	1
4. Shale, much iron oxide.....	3
5. Kanawha Black Flint, platy in upper portion, weathering fissile; thicker bedded below, weathering flaggy, and breaking irregularly; marine invertebrate fossils (less numerous in lower portion)....	4
6. Concealed, level of track.....	

The fossils are sparingly distributed through the flint and would not be noticeable on the outcrop, which is little affected by weathering, were it not for the material blasted out in the construction of the cut and lying at the side of the track. This collection has been studied in detail and is described below.

Winifrede Limestone.

One mile south of Winifrede, on Fields creek, North Hollow, 100 yards east of the mouth of South Hollow, at 970′ (barometer) A. T., but not in place, were found a few pieces of weathered limestone very full of fossils, of which only the casts are preserved. The following genera are probably represented among the fragments: *Derbya, Spirifer (cf. boonensis), Ambocoelia, Aviculipecten, Nucula* and stems of crinoids. Dr. White reports also many *Producti*[2] and places the stratum from which he obtained them 66 feet below the Winifrede coal. The outcrop of this stratum is now concealed.

Dingess Limestone.

The writer has collected from the type locality of this horizon at the village of Dingess, Mingo county, and in that vicinity, but has not yet studied the collection in detail. The

[1]D. D. Teets, p. 246, above.
[2]W. Va. Geological Survey, Vol. II(A), p. 431.

following forms were recognized on a superficial examination in the field: *Lingula* cf. *umbonata, Derbya crassa, Marginifera* sp., *Productus* (2) sp., *Myalina, Allorisma* cf. *terminale, Aviculipecten* cf. *occidentalis, Pharkidonotus percarinatus,* crinoid plate.

Good collections from this horizon have not yet been obtained from Kanawha county, but a few poorly-preserved marine fossils have been found in it at several places. The forms were chiefly *Productus cora* and a *Spirifer.* In Cabin Creek district the fossils have been found as follows:—at Shrewsbury Messrs. Krebs, Reger, and Teets report fossils; the writer has seen them at Winifrede Junction, 837′ (barometer) A. T., and up the Sandy City incline, 0.6 mile south of Eventon on Cabin creek, 980′ (barometer) A. T.; they are reported by Krebs at Cedar Grove.

Eagle Limestone.

The writer has made a large collection from the type locality of this limestone in Fayette county 500′ west of Edgewater tipple, at the C. and O. R. R. grade, 642′ A. T., 1.6 miles northeast of the mouth of Armstrong creek. A study of this collection has not been made but it is believed that it will yield at least a score of species predominantly of brachiopoda. The following forms have been recognized on a hasty examination: *Orbiculoidea* cf. *capuliformis, Derbya crassa, Chonetes* sp., *Marginifera* sp., *Productus* (2) sp., *Spirifer* sp., *Ambocoelia* sp., *Nucula parva? Nuculana* sp., *Schizodus* cf. *affinis, Schizodus* sp., *Aviculipecten* sp., *Edmondia* sp., *Euomphalus* sp., and a Pleurotomaroid.

The writer has seen the Eagle fossils also on the point on the north side of the mouth of Armstrong creek* at 860′ (barometer) A. T. under a 6-foot, oolitic, silicious limestone; also at other points in this vicinity. The fossls often extend sparingly through 30′ or more in vertical range.

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*W. Va. Geological Survey, Vol II, p. 371.

CORRELATION.

The only fossiliferous horizon of the Kanawha Series from which any data bearing on the problem of the correlation of the horizons with those of other States are at present available is the Kanawha Black Flint.

Kanawha Black Flint.

The species found in the Kanawha Black Flint at Queen Shoals throw little light on the exact stratigraphic position of the bed. Not only is the list a short one on which to base a correlation, and the collection, though large, from a single locality, but also when the geologic range and areal distributio of the species composing the list are examined the data for correlation appear very meagre. Two of the species, *Enchostoma elkensis* and *Lingula kanawhensis,* are new, and hence their range and distribution are unknown; three species, namely, *Lingula umbonata, Derbya crassa,* and *Productus cora,* are known to range through practically the entire Pennsylvanian system and into the lower Permian; and one, *Chonetes* sp., is so poorly preserved as to make specific determination impossible. Thus we are left four species upon which we must depend for results. Of these *Productus* cf. *symmetricus* is based on only a few flattened fragments and is a very uncertain determination. *Orbiculoidea capuliformis* was described from the "Coal Measures" at Springfield, Illinois. Of the remaining two, *Spirifer boonensis* Swallow ? was first found in the "Lower Coal Measures" of Missouri, but later described from the Molas and Hermosa formations of Colorado, which are considered by Girty[1] to have been deposited very early in Pennsylvanian time and to antedate probably the earliest formation of the Kansas and Nebraska Pennsylvanian rocks; also from the Wewoka formation of Oklahoma[2] which he considers to be the equivalent in age of the lower portion of these rocks in Kansas.[3]

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[1]U. S. Geological Survey, Prof. Pap., No. 16, p. 264.
[2]U. S. Geological Survey, bulletin in preparation.
[3]N. Y. Acad. Sci., Annals, Vol. XXI, p. 119.

Conularia crustula is found in Kansas in the Cherokee shale, Fort Scott limestone, Chanute shale, and Deer Creek limestone;[1] also from the Hermosa formation of Colorado, and the Wewoka formation of Oklahoma, a wide stratigraphic range. Thus no data are presented for a precise correlation within the Pennsylvanian system.

When compared with the list of fossils found in the Mercer limestone of Ohio by Miss Mark[2] no similarity is observed. The Mercer fauna contains 16 brachiopoda, 40 pelecypoda, 14 gastropoda, and a few other forms, while that of the Black Flint at Queen Shoals is composed of 8 brachiopoda, 1 conularia, and 1 annelid. *Derbya crassa* and *Productus cora* are the only species common to the two faunas as given in the lists, and these have been noted above as having a great geologic range in the Pennsylvanian. It is confidently expected that further collecting at this horizon will yield results from which a correlation may be made with the formations of adjoining areas.

The Kanawha Black Flint was deposited early in Pennsylvanian time, as has previously been determined from stratigraphic and paleobotanic evidence;[3] and the paleontoligical facts are not in conflict with this view, for, while three of the brachiopoda, *Lingula umbonata, Derbya crassa,* and *Productus cora,* are found as high as the Permian, they also range down into the lower part of the Pennsylvanian of Kansas, Oklahoma, and Colorado; all the Queen Shoals species whose range is known are found in the early formations of the three States just named; one, *Spirifer boonensis,* is not known higher than these, and also ranges down into the Mississippian, as does *Conularia crustula.* Moreover, *Enchostoma* is a Mississippian genus, this being only the third occurrence of a species of the genus noted from the Pennsylvanian.

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[1]Univ. Geol. Surv. Kansas, Vol. IX, pl. XLII, opp. p. 328.
[2]Den. Univ., Bull. Sci. Lab., Vol. XVI, art. 10, p. 306.
[3]See above, p. 255.

DESCRIPTIONS OF SPECIES.

CHAETOPODA.

Genus ENCHOSTOMA Miller and Gurley.

Enchostoma elkensis sp. nov.

Plate I, Fig. 1, 2.

Description.—This name is proposed for a lanceolate, slowly expanding, slightly sinuous shell which seems to belong to this genus. The specimen, like nearly all the fossils from the same locality, has probably been flattened by pressure. Surface nearly smooth, but ornamented by numerous low, rounded, transverse ridges and furrows of equal size; twelve ridges were counted in a length of 5 mm. where the flattened shell is from 3 to 4 mm. broad. Shell thin and phosphatic, and so flattened as to leave the two sides separated by only 0.5 mm. of the flint matrix. It is impossible to determine the shape of the cross-section of the shell before flattening.

Dimensions of fragment: length, 56 mm.; breadth of smaller end, 1 mm.; breadth of larger end (flattened), 9 mm.

The name is taken from the Elk River, which flows past tne village of Queen Shoals.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (r).*

Collection.—West Virginia Geological Survey.

Vermes incerti.

Description.—Sinuous, tubular castings, or tracks, of worms are numerous on several slabs of the flint. Sinuous borings in the shell of a *Chonetes* sp. were also observed.

Breadth, about 1 mm.; length, up to 35 mm.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (c).

Collections.—West Virginia Geological Survey, and West Virginia University.

*The following abbreviations are used in this report: a, abundant; c, common; r, rare.

BRACHIOPODA.

Genus LINGULA Bruguière.

Lingula umbonata Cox.

Plate I, Figs. 3, 4.

Lingula umbonata. Cox, 1857, Kentucky Geol. Survey, vol. iii, p. 575, pl. x, figs. 4, 4a.
Coal Measures: Crittenden, Union, and Hancock counties, Kentucky.

Description.—A few small shells are referred to this somewhat uncertain species. They vary slightly in dimensions and are from 1½ times to a little more than twice as long as the specimen described by Cox; these variations of size and shape are within the dimensions of forms previously ascribed by authors to this species and to *L. mytiloides* ? of Meek and Worthen*, which is probably the same species.

Our shells are fairly well preserved, and show, besides the concentric wrinkles of growth, the fine, wavy, concentric striae which cover the surface. These finer lines are in the central portion of the shell parallel to the striae of growth, but round less rapidly than the latter toward the sides, where they cross them at an angle, as may be seen from fig. 4, pl. I. This figure also shows extremely fine granules distributed somewhat irregularly over the surface, but at times in lines parallel to the striae of growth.

The outer layer of the shell of the figured specimen is broken away over a small area and shows beneath it two other layers; on the uppermost of these the growth lines are less marked than on the exterior, the finer, concentric striae are not seen, and faint longitudinal wrinkles appear; on the lower layer the growth lines have lost the character of wrinkles, are irregularly lobate in outline, and are visible only as light and dark bands; this layer bears a centrally-placed, longitudinal groove about 0.5 mm. wide; no traces of this groove are seen

*Geol. Surv. Ill., 1873 Vol. V, p. 572, pl. XXV, figs. 2a-c.

on the exterior of the shell, the upper layers being arched over the groove. The presence of this groove, if it is a constant feature in the species, which cannot be told from our collection, may explain the flattening of Cox's specimen as described by him, if the upper layers had been pressed down to fill the space thus left between the second and third layers of the shell; these features do not show in the reproduction.

One specimen shows on the interior the slightly thickened visceral area with its trilobate anterior outline, and several of the numerous muscle scars described for the genus by Meek and Hayden.*

Dimensions of two specimens:

Length mm.	Breadth mm.
8	5
13	8

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (r).

Collection.—West Virginia Geological Survey.

Lingula kanawhensis sp. nov.

Plate I, Figs. 5, 6.

Description.—Shell small, oval, subquadrate, thin; beak terminating at the hinge line, from which the posterior margin slopes gently away on both sides, forming a broad, flat curve; posterior margins rounding rapidly but smoothly into the lateral margins, which are nearly straight, parallel, and rounding more gradually anteriorly than posteriorly; posterior margin broadly rounded, greatest width at center; beak and umbonal regions apparently only slightly elevated above the remainder of the shell; greatest convexity apparently in the center, from which the surface falls away gradually and evenly toward the anterior and antero-lateral margins; toward the postero-lateral margins it descends more abruptly and is continued as a triangular, raised area narrowing toward the beak. Postero-lateral areas flat.

*Pal. Upper Missouri, Smithsonian Cont. to Knowl., Vol. XIV, No. 172, 1864, p. 68.

Exterior surface ornamented with numerous, fine, raised, concentric lines of alternating coarseness, the finer being the more numerous, crowded closely toward the posterior margin, more distantly separated anteriorly, those upon the anterior fourth terminating at the lateral margins, the remainder continuing to the posterior margin; between these are extremely fine, closely-placed, concentric striae which may be seen only with the aid of a 12-power magnifier. Interior of the shell very imperfectly known, but not so highly ornamented as the exterior.

Length, 22 mm.; breadth, 15 mm.; convexity (measured in the interior of shell), 2.5 mm. One entire mold of the exterior of a valve, a fragment of another with portions of the shell adhering to it, and a fragment of the mold of the anterior portion of a valve, are in our collection.

The broad, subquadrate shell, and large size distinguish it from all other Pennsylvanian species of the genus known to the author. It is associated with specimens of *L. umbonata* which are decidedly narrower and smaller. As the specimen from which the convexity was described is somewhat flattened, the measurement here given may not be typical of the species.

The name is taken from that of the county in which it was found.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT. Queen Shoals, Kanawha county, (r).

Collection.—West Virginia Geological Survey.

Genus ORBICULOIDEA d'Orbigny.

Orbiculoidea capuliformis (McChesney).

Plate I, Figs. 7-9.

Discina capuliforma. McChesney, 1860, Desc. New Pal. Foss., p. 72.
Coal Measures: Springfield, Illinois; 12 miles northwest of Richmond, Missouri.

Discina capuliformis. McChesney, 1868, Trans. Chicago Acad. Sci., vol. i, p. 23, pl. ii, fig. 20.
Coal Measures: Springfield, Illinois; 12 miles northwest of Richmond, Missouri.

Description.—This sub-circular, dome-shaped brachiopod is the most abundant fossil of the Black Flint at the locality collected from.

Brachial (convex) valve sub-circular, dome-shaped, highest back of the apex; beak situated ¼ to $^1/_8$ diameter of shell from margin; ratio of convexity to diameter (from a shell which shows little crushing) 1 to 5; largest brachial valve of our collections measures in diameter 28 to 31 mm; specimen from which the latter measurement was obtained is partly exfoliated at the apex, and shows on the upper surface of one of the layers of the shell a narrow, straight groove, characteristic of the genus, extending from just back of the very apex in an anterior direction until it is covered by an upper layer of the shell.

Pedicle valve sub-circular, flat, provided with a lanceolate pedicle opening extending from the beak toward the margin a distance of from 2 to 6 mm., but never reaching it in any of the numerous specimens of our collection; in at least two instances a narrow and slightly depressed line extends from the end of the slit to the margin. One small valve 4.5 mm. in diameter has the shell continuous beyond the slit for ¼ mm. before the margin is reached. Slit gaping, edges raised, sides converging toward the margin and fusing again before reaching it; beak of this valve central, or only slightly eccentric; surface of both valves covered with numerous, fine, concentric striae, and faint radial wrinkles not uniformily developed and not seen on all shells; largest pedicle valve measured has a diameter of 22 mm.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (a).

Collections.—West Virginia Geological Survey, and West Virginia University.

Genus DERBYA Waagen.

Derbya crassa (Meek and Hayden).

Orthis umbraculum? Hall, 1852, Stansb. Expd. Great Salt Lake, p. 412, pl. iii, fig. 6.

Carboniferous: Missouri River above Fort Leavenworth.

Orthis umbraculum? Owen, 1852, Geol. Survey, Wisconsin, Iowa, and Minnesota, pl. v, fig. 11.

Carboniferous: Missouri River, near mouth of Keg Creek, and at Council Bluffs.

Orthis arachnoidea. Roemer (non Phillips), 1852, Kreid. von Texas, p. 89, pl. xi, figs. 9a-b.

Carboniferous: San Saba Valley, Texas.

Orthis arachnoidea. Hall, 1857, Mexican Boundary Survey, pl. xx, fig. 3.

Orthisina crassa. Meek and Hayden, 1858, Acad, Nat. Sci., Philadelphia, Proc., p. 261.

Coal Measures: Leavenworth, Kansas.

Description.—A few impressions of a small, but characteristic, *D. crassa* were collected from the Black Flint; these exhibit only the exterior of the shell; fine, concentric lines crossing the well-marked, radiating striae are only faintly shown, due in all probability to the rather imperfect preservation of the specimens.

Length mm.	Breadth mm.
10 (distorted specimen)	12
9 (probably fragmentary)	12
16	15 (restored)
10 plus	13

Number of striae at distance of 14 mm. from beak, 48.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT. Queen Shoals, Kanawha county, (r).

Collections.—West Virginia Geological Survey, and West Virginia University.

Genus CHONETES Fischer de Waldheim.

Chonetes sp.

Description.—Several specimens of a small finely striated *Chonetes* having about the outline of *C. verneuilanus* or *C. granulifer,* but too poorly preserved to distinguish its diagnostic features, were found. The surface of one is grooved by several, fine, sinuous worm borings.

Breadth, 16 mm.; length, 7.5 mm.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (r).

Collection.—West Virginia Geological Survey.

Genus PRODUCTUS Sowerby.

Productus cf. cora d'Orbigny.

Productus cora. D'Orbigny, 1842, Voyage dans l'Amérique Méridionale, vol. iii, pt. iv, p. 55.

Carboniferous: Above Patapatoni, on an island in Lake Titicaca; Yarbichambi.

Description.—Several fragments of a *Productus* show fine, thread-like lines, nearly parallel, but at times wavy, increasing by bifurcation; a few large tubercules scattered over the surface; outline of shell unknown.

The markings resemble those of *P. Cora,* and several fragments show it to have been a broad shell.

Occurrence.—Kanawha Series, *Kanawha Black Flint,* Queen Shoals, Kanawha county, (r).

Collections.—West Virginia Geological Survey, and West Virginia University.

Productus cf. symmetricus McChesney.

Productus symmetricus. McChesney, 1860. Desc. New Pal. Foss., p. 35.

Upper Coal Measures: Lasalle and Springfield, Illinois.

Productus symmetricus. McChesney, 1865. Ill. New Spec. Foss., pl. i, figs. 9a-b.

Description.—A cast of a flattened fragment of what appears to have been *P. symmetricus* is in our collections. Concentric wrinkles, and numerous spine scars arranged in concentric lines are the only surface features shown. These suggest strongly this species.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (r).

Collection.—West Virginia Geological Survey.

Genus SPIRIFER Sowerby.

Spirifer boonensis Swallow ?

Plate II, Figs. 1-3.

Spirifer boonensis. Swallow, 1860, St. Louis Acad. Sci., Trans., vol. i, p. 646.

Lower Coal Measures: Boone, Randolph, and Monroe counties, Missouri.

Description.—This species is one of the most abundant in the Kanawha Black Flint at Queen Shoals, Kanawha county. Many specimens show evidences of crushing and distortion by pressure, and probably none exhibit their natural convexity; beak in all cases flattened, and often cannot be extricated from the flint matrix; known only from impressions of the exterior of the shell.

Girty has admirably discussed the relations of his Colorado material,* with which the Queen Shoals specimens have been compared and found to be essentially the same. The characters in which the specimens from West Virginia resemble those from Colorado are, size, transverse shape, extended and pointed cardinal extremities, hinge line always forming the greatest dimension of the shell, subquadrate outline in older individuals, 4 to 5, or 6, ribs upon the fold and sinus, and the fine, concentric striae. Slight differences exist which are in the writer's estimation not of specific value in view of the poor state of preservation of the West Virginia forms; namely, possession by our forms of apparently from 10 to 12 lateral plications, and not 12 to 13, as on shells from Colorado; absence on specimens from West Virginia of the fine, radiating striae of Colorado shells.

Girty's illustrations show the plications in the region of the mesial fold and sinus to be fasciculate, while those upon the lateral portions are coextensive with each other, the same feature being seen on our shells.

The fine, concentric striae of our fossils are seen on only a few specimens; of these 11 were counted in the space of 5

*Girty, G. H., U. S. Geol. Survey, Prof. Paper, No. 16, p. 381.

mm. from the anterior margin toward the hinge line. Foramen not usually seen, but one specimen shows it to be like that in Girty's figure; area in one specimen apparently finely-striate vertically.

Ratio of breadth to length, 2 to 1; greatest thickness of the mashed specimens, 2 mm; measurements of 5 specimens:

Breadth mm.	Length mm.
32	17 plus
32 plus	16
28 plus	12 plus
31	16
23	11
35	19

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (a).

Collections.—West Virginia Geological Survey, and West Virginia University.

GASTROPODA.

Genus CONULARIA Miller.

Conularia crustula White ?

Plate II, Figs. 4-6.

Connularia crustula. White, 1880, U. S. Geol. Geog. Surv. Terr., Twelfth Ann. Rept., for 1878, pt. 1, p. 170, pl. xlii, fig. 4a.

Coal Measures: Kansas City, Missouri; near Taos, New Mexico.

Description.—Our collection includes numerous fragments of a form similar to that commonly referred to *C. crustula.* The specimens are all crushed and flattened, but show the triangular sides, and the general form and sculpturing of White's figures and description.

The original description of this species is not full, and hence it is not with certainty that the West Virginia forms are referred to it.

Our shell shows the following differences from White's description: size somewhat larger, one fragment having a breadth of 25 mm. on a side, and a preserved length of 75 mm.,

in the middle of each side, instead of a furrow, a faint line is seen caused by the slight thickening, the interruption—the ends not meeting but passing each other slightly—or both the thickening and interruption of the transverse, raised striae; this thickening of the striae is due in most cases to a division of the rib into two, as may be seen under a magnifier; where the rib is not interrupted the division is represented by a shallow groove in the center of the rib; one specimen has its ribs interrupted twice on one side for a portion of its length; thickening without interruption, interruption and division of the interrupted ends of the striae may all occur on different portions of the same side of the shell; no crenulations are observable on the striae, but the imperfect state of preservation of the material may account for their absence; irregular longitudinal wrinkles are seen on some specimens between the ribs. The shell is thin. It is not thought that the above points of difference between our shell and White's are of specific value.

Occurrence.—Kanawha Series, KANAWHA BLACK FLINT, Queen Shoals, Kanawha county, (c).

Collections.—West Virginia Geological Survey, and West Virginia University.

PLATE I.

Page

Figs. 1 and 2. *Enchostoma elkensis* sp. nov... 645
1. Portion of the above.....x 3. Holotype.
Kanawha Black Flint, Queen Shoals, Kanawha county, (r).
2. A fragmentary, crushed specimen showing a portion of the exterior of the test with below it the cast of the exterior of the opposite side, and above it the impression of the interior.....x 1.

Figs. 3 and 4. *Lingula umbonata* Cox... 646
3. Large-sized specimen showing exterior of shell, partly restored.....x 1.
4. Detail of surface of same.....x 15.
Kanawha Black Flint, Queen Shoals, Kanawha county, (r).

Figs. 5 and 6. *Lingula kanawhensis* sp. nov..... 647
5. Exterior somewhat wrinkled by pressure ap-

STANFORD

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F. Wieser, del.

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F. Wieser, del.

plied longitudinally; posterior end accordingly more blunt than that of an unwrinkled fragment in the collection.....x 1.
Holotype.
6. Fragment of natural cast of anterior and lateral portions of interior of another shell. Posterior portion restored.....x 1.
Paratype.
Kanawha Black Flint, Queen Shoals, Kanawha county, (r).

Figs. 7 to 9. *Orbiculoidea capuliformis* (McChesney).. 648
7. Large brachial valve, somewhat crushed, and exfoliated .....x 1.
8. Medium-sized, pedicle valve; partly exfoliated showing pedicle slit.....x 1.
9. Profile; uncrushed brachial valve.....x 1.
Kanawha Black Flint, Queen Shoals, Kanawha county, (a).

PLATE II.

Figs. 1 to 3. *Spirifer boonensis* Swallow?..... 652
1. Brachial valve, wing restored; with area and portion of flattened beak; foramen (?) indistinctly seen.....x 1.
2. Brachial valve .....x 1.
3. Fragment of large pedicle valve showing fine, lamellose, growth lines.....x 1.
Kanawha Black Flint, Queen Shoals, Kanawha county, (a).

Figs. 4 to 6. *Conularia crustula* White?..... 653
4. Showing two sides of shell and portion of third side flattened into the same plane; transverse striae finer than the average.....x 1.
5. Transverse striae of average coarseness, showing thickening of same in center of side...x 1.
6. Specimen of average coarseness of striae, showing interruption and interlocking of ends of same .....x 3.
Kanawha Black Flint, Queen Shoals, Kanawha county, (c).

APPENDIX.

LEVELS ABOVE MEAN TIDE IN KANAWHA COUNTY.

MAIN LINE CHESAPEAKE & OHIO RAILROAD.

Miles from Ft. Monroe	STATIONS	State.	County.	Elevation.
417.9	Kanawha Falls	W. Va.	Fayette	677
421.6	Deep Water	W. Va.	Fayette	656
423.6	Mt. Carbon	W. Va.	Fayette	647
425.1	St. Clair	W. Va.	Fayette	....
425.3	Eagle	W. Va.	Fayette	650
425.9	Edgewater	W. Va.	Fayette	....
426.6	Crescent	W. Va.	Fayette	....
427.5	Montgomery	W. Va.	Fayette	645
428.9	Morris Creek Junc.	W. Va.	Kanawha	....
429.0	Consolidated	W. Va.	Kanawha	....
429.6	Handley	W. Va.	Kanawha	639
431.7	Paint Creek Junc.	W. Va.	Kanawha	629
432.8	Hansford	W. Va.	Kanawha	....
433.5	Crown Hill	W. Va.	Kanawha	....
434.1	Belmont	W. Va.	Kanawha	....
435.08	Black Cat	W. Va.	Kanawha	....
435.6	East Bank	W. Va.	Kanawha	....
437.5	Coalburg	W. Va.	Kanawha	632
438.2	Cabin Creek Junc.	W. Va.	Kanawha	630
438.5	Chelyan	W. Va.	Kanawha	....
440.6	Winifrede	W. Va.	Kanawha	624
444.5	Marmet	W. Va.	Kanawha	616
445.7	Carkin	W. Va.	Kanawha	....
448.2	Malden	W. Va.	Kanawha	614
449.8	Kanawha	W. Va.	Kanawha	....
451.8	South Ruffner	W. Va.	Kanawha	613
453.6	Charleston	W. Va.	Kanawha	611
455.2	Elk	W. Va.	Kanawha	....
457.2	South Charleston	W. Va.	Kanawha	....
458.9	Spring Hill	W. Va.	Kanawha	605
465.5	St. Albans	W. Va.	Kanawha	600
466.9	Lewis	W. Va.	Kanawha	....
469.6	Scary	W. Va.	Putnam	....
473.2	Scott	W. Va.	Putnam	....

PAINT CREEK BRANCH.

Miles from Pt. Creek Junction	STATIONS	State.	County.	Elevation.
0.0	Pt. Creek Junction.	W. Va....	Kanawha	629
1.5	Scale Yard.....	W. Va....	Kanawha	....
3.6	Mucklow	W. Va....	Kanawha	662
4.7	Wacomah	W. Va....	Kanawha	....
5.9	Standard	W. Va....	Kanawha	707
6.0	Bedford	W. Va....	Kanawha	....
7.5	Detroit	W. Va....	Kanawha	....
8.9	Morton	W. Va....	Kanawha	766
10.0	Nuckolls	W. Va....	Kanawha	....
11.0	Tomsburg	W. Va....	Kanawha	....
12.0	Greencastle	W. Va....	Kanawha	846
12.9	Imperial Junction..	W. Va....	Kanawha	....
13.0	Burnwell	W. Va....	Kanawha	....
12.9	Imperial Junction..	W. Va....	Kanawha	....
14.8	Hickory Camp.....	W. Va....	Fayette	929
15.5	Mahan	W. Va....	Fayette	966

CABIN CREEK BRANCH.

Miles from Cabin Creek Junction	STATIONS	State.	County.	Elevation.
0.0	Cabin Creek Junc..	W. Va....	Kanawha	630
2.0	Dry Branch.....	W. Va....	Kanawha	....
3.7	Ronda	W. Va....	Kanawha	674
5.4	Fairfield	W. Va....	Kanawha	710
7.0	Oakley	W. Va....	Kanawha	....
....	Oley	W. Va....	Kanawha	....
10.0	Cane Fork.....	W. Va....	Kanawha	....
11.4	Leewood	W. Va....	Kanawha	880
14.0	Acme	W. Va....	Kanawha	1110
20.0	Seng Creek.....	W. Va....	Kanawha	1480
23.0	Coal River.....	W. Va....	Kanawha	....
24.0	Jarrolds Valley....	W. Va....	Kanawha	820
30.0	Honaker Lawson...	W. Va....	Kanawha	1020

DECOTA BRANCH.

Miles from Leewood	STATIONS	State.	County.	Elevation.
0.0	Leewood	W. Va....	Kanawha	880
2.0	Wake Forest.....	W. Va....	Kanawha	1010
5.0	Decota	W. Va....	Kanawha	1125
7.0	United	W. Va....	Kanawha	1365

ACME & KAYFORD BRANCH.

Miles from Acme	STATIONS	State.	County.	Elevation.
0.0	Acme	W. Va.	Kanawha	1110
2.0	Kayford	W. Va.	Kanawha	1335

COAL RIVER RAILWAY.

Miles from St. Albans.	STATIONS	County	Elevation of Low Water	Elevation of Sub-Grade
0.0	St. Albans	Kanawha	554	581.0
1.7	Indian	Kanawha	....	578.0
2.5	Calvert	Kanawha	....	591.0
4.8	Ferrell	Kanawha	....	592.0
6.0	Upper Falls	Kanawha	....	604.0
7.6	Lincoln	Kanawha	....	597.5
10.2	Faqua	Kanawha	....	602.2
11.2	Ballard	Kanawha	....	604.0
11.9	Alum Creek	Kanawha	....	609.0
13.0	Forks of Coal	Kanawha	....	608.0
15.2	Sproul	Kanawha	582.0	610.1
17.1	Brounland	Kanawha	....	613.7
17.9	Hollyhurst	Kanawha	....	622.0
20.2	Emmons	Kanawha	....	627.0
21.2	Morris	Kanawha	....	629.0
23.2	Dartmont	Boone	....	636.0
24.1	Ashford	Boone	....	641.0
25.6	Brushton	Boone	615.0	643.0
29.2	Peytona	Boone	....	660.0
30.4	Indian Creek	Boone	638.0	662.0
31.1	Racine	Boone	644.5	675.0
36.4	Seth	Boone	....	658.6

LITTLE COAL RIVER BRANCH.

Miles from St. Albans.	STATIONS	County	Elevation of Low Water	Elevation of Sub-Grade
15.2	Sproul	Kanawha	....	610.1
16.7	Bluetom	Lincoln	587.0	620.0
17.2	Rolman	Lincoln	588.0	625.0
19.5	Dunlap	Lincoln	597.6	626.0
22.0	MacCorkle	Lincoln	612.0	633.0
24.3	Ivy Branch	Lincoln	....	640.0
26.8	Altman	Lincoln	622.0	650.0
27.5	Julian	Lincoln	....	650.0
28.2	Sayre	Lincoln	....	650.2
30.0	Lory	Boone	....	658.6
32.7	Rock Creek	Boone	639.8	668.0
33.8	Hopkins	Boone	....	671.0
35.2	Danville	Boone	....	674.0
37.3	Madison	Boone	....	687.5

KANAWHA & MICHIGAN RAILWAY.

Data furnished by R. P. Black, Engineer M. of W.

Distances from Toledo	STATIONS	State.	County.	Elevation.
304.0	Raymond City	W. Va.	Putnam	596.1
305.0	Poca	W. Va.	Putnam	.....
	Putnam	W. Va.	Putnam	581.8
309.3	Lock Seven	W. Va.	Kanawha	587.6
311.1	Sattes	W. Va.	Kanawha	586.1
314.4	Institute	W. Va.	Kanawha	592.6
314.8	Farm	W. Va.	Kanawha	589.9
316.7	Dunbar	W. Va.	Kanawha	593.0
	Rochelle	W. Va.	Kanawha	591.0
318.6	Mound	W. Va.	Kanawha	591.0
	Sheldon	W. Va.	Kanawha	593.1
321.0	West Charleston	W. Va.	Kanawha	597.1
322.3	Watts Street	W. Va.	Kanawha	598.8
323.4	Charleston	W. Va.	Kanawha	592.1
324.3	Elizabeth Street	W. Va.	Kanawha	597.3
326.5	Snow Hill	W. Va.	Kanawha	597.0
328.5	Dana	W. Va.	Kanawha	600.5
329.6	Malden	W. Va.	Kanawha	601.5
	Furnace	W. Va.	Kanawha	601.5
331.3	Haskett	W. Va.	Kanawha	610.26
333.7	Platt	W. Va.	Kanawha	604.1
335.2	Belle	W. Va.	Kanawha	604.1
336.6	Witcher	W. Va.	Kanawha	604.1
337.2	Dickinson	W. Va.	Kanawha	626.0
339.5	Shrewsberry	W. Va.	Kanawha	614.0
340.3	Monarch	W. Va.	Kanawha	614.0
341.6	Cedar Grove	W. Va.	Kanawha	631.5
343.7	Riverside	W. Va.	Kanawha	622.0
345.2	Hugheston	W. Va.	Kanawha	622.0
346.6	London	W. Va.	Kanawha	629.0
349.8	Cannelton	W. Va.	Kanawha	635.0
350.4	Smithers	W. Va.	Kanawha	632.0
351.2	Longacre	W. Va.	Kanawha	639.5
352.4	Harewood	W. Va.	Kanawha	636.0
352.8	Boomer	W. Va.	Kanawha	651.5
355.5	Falls View	W. Va.	Kanawha	649.5
359.1	Glen Ferris	W. Va.	Kanawha	672.0
360.6	Gauley Bridge	W. Va.	Kanawha	671.4

TABLE OF ELEVATIONS OF ALL STATIONS ON THE KANAWHA AND WEST VIRGINIA RAILROAD.

Distances from Ch'leston	STATIONS	State.	County.	Elevation.
0.0	Charleston	W. Va.	Kanawha	600
4.4	Mink Shoals	W. Va.	Kanawha	611
6.9	Coopers	W. Va.	Kanawha	611
7.5	Big Chimney	W. Va.	Kanawha	615
8.2	Elrod	W. Va.	Kanawha	612
9.1	Sandy	W. Va.	Kanawha	615
11.3	Price	W. Va.	Kanawha	615
11.7	Elkview	W. Va.	Kanawha	615
13.3	Blue Creek	W. Va.	Kanawha	619
15.9	Three Mile	W. Va.	Kanawha	639
17.0	Shrader	W. Va.	Kanawha	646
18.3	Coco	W. Va.	Kanawha	657
19.5	Carpenter	W. Va.	Kanawha	670
21.6	Quick	W. Va.	Kanawha	683
22.2	Roderick	W. Va.	Kanawha	688
25.0	Morris	W. Va.	Kanawha	726
27.0	Rock Camp	W. Va.	Kanawha	761
28.0	Middle Fork	W. Va.	Kanawha	780
31.1	Pond Fork	W. Va.	Kanawha	894
32.0	Willis Hollow	W. Va.	Kanawha	994
33.4	Blakeley	W. Va.	Kanawha	1116

COAL & COKE RAILWAY COMPANY.

Distance from Ch'leston	STATIONS	State.	County.	Elevation.
0.0	Charleston	W. Va.	Kanawha	597
3.8	Barlow	W. Va.	Kanawha	605
6.0	Mill Creek	W. Va.	Kanawha	603
7.3	Masons	W. Va.	Kanawha	607
10.3	Pinch	W. Va.	Kanawha	609
11.0	Jarrett's Ford	W. Va.	Kanawha	616
13.0	Blue Creek	W. Va.	Kanawha	614
17.0	Falling Rock	W. Va.	Kanawha	617
18.6	Reamer	W. Va.	Kanawha	624
20.5	Clendenin	W. Va.	Kanawha	625
22.7	Turner	W. Va.	Kanawha	633
24.4	Queen Shoals	W. Va.	Kanawha	638
27.6	Porters	W. Va.	Clay	644
28.9	Rand	W. Va.	Clay	646
30.3	King	W. Va.	Clay	651
31.8	Camp	W. Va.	Clay	651
35.9	Shelly Junction	W. Va.	Clay	663
38.4	Birch	W. Va.	Clay	669
39.5	Shelton	W. Va.	Clay	672
41.1	Big Sycamore	W. Va.	Clay	674
44.2	Elkhurst	W. Va.	Clay	682
47.2	Middle Creek	W. Va.	Clay	699
48.1	Upper Leatherwood	W. Va.	Clay	701
50.8	Clay C. H.	W. Va.	Clay	706

LEVELS ABOVE TIDE IN THE KANAWHA AREA, DETERMINED BY THE U. S. GEOLOGICAL SURVEY.

The elevations in the following list are based upon the 1903 adjustment of the precise level net.

Leveling in Clendenin and Montgomery quadrangles in 1907 by Orr Meredith; on Montgomery quadrangle in 1908 by E. S. Dawson; and in 1908 all by C. M. Bennett.

CLENDENIN 15′ QUADRANGLE.

POINT 1.3 MILES NORTHEAST OF COAL FORK STATION ON CAMPBELL CREEK RAILROAD, NORTHEAST, VIA FIVEMILE FORK AND RIGHT FORK OF BLUE CREEK, TO POINT 1.52 MILES NORTHEAST OF QUICK; THENCE SOUTHEAST UP BLUE CREEK, MIDDLE FORK AND POND FORK, TO POND GAP; THENCE SOUTHWEST TO WARD STATION.

	Feet.
Fivemile Fork, 0.43 mile north of mouth, 125 feet northeast of house, north of road, in sandstone bowlder; aluminum tablet stamped "719"	717.966
Quick, 1.3 miles west of, 0.25 mile west of fork of road north to Coco between road and Right Fork of Blue Creek, on south edge of road, in sandstone bowlder; aluminum tablet stamped "830"	829.753
Quick, 2.9 mile east of, 0.2 mile east of railroad crossing, in east end of rock cliff lying along railroad east of Sandlick branch; aluminum tablet stamped "718"	717.307
Middle Fork, 0.5 mile west of station, 0.4 mile east of Rockcamp Fork, in masonry at west end of railroad bridge; aluminum tablet stamped "768"	767.601
Middle Fork, 2.38 miles southeast of, 3.25 miles northwest of Blakeley, 0.21 mile southeast of Turner Fork, at north end of railroad trestle, creek and road at foot of cliff, in rock ledge at south side of track; aluminum tablet stamped "865"	863.469
Blakeley, 0.64 mile north of station, south of track at Kanawha and West Virginia Railroad crossing, 4 feet above track, in sandstone cliff; aluminum tablet stamped "1078"	1,075.616
Blakeley, in front of station; top of rail	1,112.5
Mammoth, 3.75 miles northeast of, 300 feet up from foot of hill at head of Hurricane Fork of Kelly Creek, north of road, in sandstone ledge; aluminum tablet stamped "1273"	1,270.758

POINT 1.52 MILES NORTHEAST OF QUICK POSTOFFICE, NORTH ALONG PUBLIC HIGHWAYS, VIA FALLING ROCK CREEK AND COAL AND COKE RAILWAY, TO WELLFORD.

	Feet.
Odell, east of road, in southwest corner of stone foundation to dwelling; aluminum tablet stamped "1215"	1,214.077

Odell, 3.06 miles northeast of, 50 feet north of company store at mouth of Evans Fork of Falling Rock Creek, 60 feet north of road to Apgah at foot of hill; in large sandstone; aluminum tablet stamped "?" 794.464

Weir, 2.9 miles south of, at north side of creek bottom, 250 feet north of Falling Rock Creek, 0.38 miles east of cannel-coal mine, in bowlder; aluminum tablet stamped "714".... 713.929

Weir, 0.16 mile south of postoffice, 400 feet south of trestle over Laurel Fork, creek on opposite side of track, north of railroad, in sandstone rock; aluminum tablet stamped "647" 646.652

Reamer, 1,600 feet west of, south of Coal and Coke railway track, in capstone of viaduct over Leatherwood creek; aluminum tablet stamped "618" 617.454

Clendenin, 1.14 miles north of, near ford crossing to house on east bank of Big Sandy creek, west of road near foot of bank, in sandstone outcrop; aluminum tablet stamped "624" 623.389

CLENDENIN, EAST ALONG COAL AND COKE RAILWAY, TO RAND.

Feet.

Clendenin, 0.33 mile north of, 600 feet north of dwelling, at upper side of road up Big Sandy Creek, on sandstone outcrop, chiseled square; painted "621" 620.80

Turner, in front of station; top of rail 636.3

Turner, 0.72 mile east of station, 1.1 miles west of Queen Shoals station, 12 feet south of track, nearly opposite west house in group of four, in brown sandstone bowlder, aluminum tablet stamped "645" 644.117

Barren Creek, 0.26 miles west of postoffice, 20 feet south of track, opposite east end of warehouse near lampblack factory, on sandstone bowlder, chiseled square; marked "644" 643.59

Porter, 0.82 mile west of station, 10 feet southwest of track, in blue sandstone outcrop; aluminum tablet stamped "646".... 645.663

Porter, in front of station; top of rail 644.4

Porter, 0.4 mile east of station, 10 feet south of track, 300 feet east of house on opposite side of track, on brown sandstone bowlder, chiseled square; marked "648" 648.08

MONTGOMERY 15′ QUADRANGLE.

DICKINSON, SOUTHEAST, TO CABIN CREEK JUNCTION; THENCE SOUTH ALONG CHESAPEAKE AND OHIO RAILROAD AND SOUTHWEST 3 MILES UP COAL FORK.

Feet.

Cabin Creek Junction, 1 mile south of, east of railroad, and creek, 240 feet north of hollow, 0.3 mile south of mouth of Cabin Creek, in outcrop of sandstone; chiseled square; painted "621" 620.10

Dry Branch, 0.7 mile northwest of postoffice, north of railroad and river, 40 feet east of trail over point, in sandstone cliff; aluminum tablet stamped "621" 620.573

Dry Branch, 1.5 miles southeast of, at south end of cut, east of railroad, 0.1 mile north of coal tipple, on top of outcrop of rock, chiseled square; painted "658" 657.25

Sharon, 200 feet west of postoffice, 75 feet west of railroad bridge over Cabin Creek, opposite mouth of Paint Branch, between station and Cabin Creek, in second stone in abutment at northeast end of bridge over small run; aluminum tablet stamped "668"..... 667.191
Ohley, 1.2 miles northwest of postoffice, west of Chesapeake and Ohio Railway, 400 feet north of mouth of Coal Fork, in outcrop of rock; aluminum tablet stamped "742"..... 740.840
Ohley, 4 miles west of, north of road, in bank, 30 feet off road, 0.1 mile northwest of house, in large rock bowlder; aluminum tablet stamped "919"..... 917.858

POINT 1.95 MILES WEST OF CEDAR GROVE, NORTHEAST UP KELLY CREEK TO WARD.

	Feet.
Cedar Grove, 1.95 west of, in east abutment of railroad culvert; aluminum tablet stamped "618".....	617.316
Cedar Grove, 1,500 feet east of station, in masonry in west end of culvert on Kelly Creek and Northwestern Railroad, aluminum tablet stamped "615".....	612.547
Ward, 900 feet east of station, 15 feet south of railroad, at edge of Kelly creek, in large bowlder; aluminum tablet stamped "717".....	714.629

The elevations in the following lists are based upon the 1903 adjustment, and upon corrected levels of the Great Kanawha River Survey of the Army Engineers, checked by primary leveling from the Ohio River Survey precise level line. Some of the descriptions were previously published under Charleston and Oceana (30′) quadrangles in the appendices to the 18th and 19th annual reports of the Director, and the additional descriptions result from work of 1907 and 1908. The elevations now given for the bench marks previously described in the 19th annual report are mostly derived by subtracting 0.925 foot from the values there given; they are 3.855 feet greater than by the datum of the old Great Kanawha River levels and check 0.089 foot low on the Coast and Geodetic Survey old elevation for the "West Base" monument at St. Albans, West Virginia, derived by vertical angulation, upon which the work in the appendix to the 18th annual report was based. The work is now subdivided into 15′ quadrangles.

Leveling was done on each in 1896 and 1897 by Hargraves Wood; additional elevations were established in 1907 in the Charleston by R. A. Kiger and in 1908 in the Peytona and Madison by E. S. Dawson.

The standard bench marks set in 1897 and 1908 are stamped mostly 1 foot too high, while those set in 1896 and 1907 are stamped mostly correct.

CHARLESTON SPECIAL QUADRANGLE.

POINT 1.03 MILES WEST OF DANA, EAST OF POINT 1.3 MILES NORTHEAST OF COAL FORK STATION ON CAMPBELL CREEK RAILROAD.

Coal Fork, 1.3 miles northeast of station, 10 feet west of track at west end of cut, in sandstone; aluminum tablet stamped "637" 636.726

MOUND, EAST TO CHARLESTON; THENCE NORTH TO WALLACE ON TUPPER CREEK.

Feet.

Mound (Lock 6 on Kanawha River); top of coping stone (Elevation by engineering corps, 565.5)..... 569.355
Charleston, 2.75 miles northwest of, on sandstone from north wall of stone arch bridge over Twomile creek, known as Twomile bridge; chiseled cross in square..... 596.10
Charleston, 1.25 miles northwest of State capitol, on sandstone wall at southeast corner of stone arch bridge, 0.5 mile northwest of suspension bridge across Elk river; chiseled cross in square 593.70
Charleston, in southwest corner of State capitol, bronze tablet stamped "602-C"..... 600.703
Patrick, 3 miles north of, 200 feet southwest of Methodist church known as Wesley Chapel, on Twomile creek; copper bolt in bowlder; stamped "604-C"..... 603.826
Wallace, 0.75 mile east of store (8 miles north of Patrick) on south edge of road, 600 feet east of James Wallace's house, in bowlder; copper bolt stamped "668-C"..... 666.752
Rocky Fork, 3 miles north of, south side of Martin Branch, 0.25 mile above mouth, 175 feet west of first crossing near school house, in rock ledge 1 foot above grade; copper bolt stamped "592-C"..... 591.017

MOUND, NORTH TO TYLER CREEK SCHOOLHOUSE.

Feet.

Mound, 2 miles northwest of, 0.25 mile southeast of fork of road near Tyler schoolhouse, in rock 20 feet west of drain; copper bolt stamped "623-C"..... 623.371

MOUND, SOUTH UP MIDDLE FORK OF DAVIS CREEK, TO MOUTH OF LONG BRANCH.

Feet.

Ruth, 2 miles east of, on west side of Middle Fork of Davis Creek, 900 feet north of mouth of Long Branch, between third and second crossings north of schoolhouse, in large bowlder near Davis Creek; copper bolt stamper "C-659".... 659.262

MARMET, SOUTH TO BROWNSTOWN.

	Feet.
Lock 5 near Marmet; coping (U. S. Engineer Corps elevation, 572.50)	576.355
Rush Creek, 0.75 mile northwest of Chesapeake and Ohio Railway culvert over, in middle one of three ledges of rock west side of Right Fork Creek; copper bolt stamped "639-C"	638.943

ST. ALBANS 15′ QUADRANGLE.

POCA, SOUTH ALONG KANAWHA AND MICHIGAN RAILWAY, TO ST. ALBANS.

	Feet.
Poca station, 300 feet south of, in west side of south abutment of highway bridge over Correly Branch; copper bolt stamped "572-C"	572.341
Lock 7; top of coping (U. S. Engineer Corps elevation, 555.50)	559.355
St. Albans, fence line on west side of First street, 60 feet north of north rail of Chesapeake and Ohio Railway track, in center of west base of monument, top of limestone post projecting 1 foot above ground; copper bolt (Coast and Geodetic Survey elevation, 594.78)	594.691

ST. ALBANS, NORTHWEST ALONG CHESAPEAKE AND OHIO RAILWAY, TO SCOTT STATION.

	Feet.
St. Albans, in front of station; top of rail	596.4
Scott, 75 feet south of station, in Pine's orchard, 50 feet south of Chesapeake and Ohio Railway tracks; iron post stamped "693-C"	692.856

ST. ALBANS, WEST, VIA TACKETT CREEK, TO YOUNG'S STORE; THENCE SOUTH TO GARRETS BEND; THENCE NORTHEAST TO ST. ALBANS.

	Feet.
St. Albans, 5 miles west of, south of road, first house south of Young's store, belonging to John Hodges, in east chimney 6 feet from ground; copper bolt stamped "U. S. G. S. "737"	737.294
Garretts Bend, 2 miles north of, Trace Fork Mud River, 200 feet below mouth of Twomile Branch, 400 feet northwest of Anderson McAllister's house, north side of stream, in huge rock; copper bolt stamped "U. S. G. S. 669"	669.125
Tornado, 1.5 miles southwest of, on road up Falls Creek, on south side of road 150 feet above the first crossing of Falls Creek; iron post stamped "614"	613.708

PEYTONA 15′ QUADRANGLE.

POINT 3 MILES UP COAL FORK OF CABIN CREEK, WEST VIA COAL RIVER AND LAUREL CREEK, TO MOUTH OF ROBINSON CREEK, 1.5 MILES EAST OF UNEEDA.

	Feet.
Ohley, 4.7 miles southwest of, north of road, opposite house, 400 feet northwest of house and hollow, near bend in creek, on rock cliff, chiseled square; painted "983"	981.74

BROWNSTONE, SOUTHWEST, ALONG LENS AND SHORT CREEKS, TO RACINE; THENCE NORTHWEST, DOWN COAL RIVER, TO COBBS.

	Feet.
Hernshaw, 1 mile south of, south side of road, on south bank of Lens Creek, near A. Hoffman's house, in 3x5 foot ledge rock; copper bolt stamped "722-C"	722.185
Peytona, 2 miles northwest of, south side of road down Coal River, 100 feet northwest of Laurel Branch, 1 mile below Whiteoak Branch, in ledge of rock; copper bolt stamped "665-C"	665.401
Cobbs, 200 feet north of mouth of Lick Creek, west side of Coal River road, in rock; copper bolt stamped "648-C"	648.375

INDEX

A

Page

Aarons fork....48
Aarons section....149
Abney, F. W., No. 1....304i, 384
Acme & Kayford Branch, C. & O. R. R....658
Acre, Geo., Nos. 1 and 2....304e
Acres, Adam....200
Aetna School House section....132
Agriculture....611-14
Allegheny Series:
  Chapter on....183-209
  Minable coals....419-54
  Sections of....183-209
  Thickness of....107
Allen Heirs....304j
Alexander Rock Quarry section....268
Alumville section....138, 173
Ames limestone....169
Analyses:
  Cannel coal....421, 439, 485, 513, 561
  Clay....580, 582, 585, 586, 587
  Coal:
    Cedar Grove....526
    Coalburg....489
    Eagle....561, 564 565
    Miscellaneous....163, 174, 450, 462, 556-7
    No. 2 Gas....552-3, 555-7
    No. 5 Block....453
    Peerless....533
    Pittsburgh....416
    Powellton....558-9
    Stockton-Lewiston....473
    Thacker....515-16
  Iron ore....601
  Kanawha Black Flint....265
  Sandstone....591, 593
  Soils....610-34
Anchor Coal Co....102, 450
Andrews, Prof....169
Angel Fork section....175
Ansted coal....283
Anticline, Definition of....55
Anticlines, Account of:
  Arches Fork....60
  Byrnside....59
  Hansford....61
  Milliken....59
  Wake Forest....61
  Warfield....59
  Winifrede....61
Apgah section....78, 197
Appendix....656
Arches Fork anticline....60
Area of Kanawha county....1-2
Arnoldsburg sandstone....122
Ault Land Co. Mine....493
Ault Lumber Co. wells....304i
Available coal, Summary of....566-9
Axes of folds....55

B

Page

Bailey, G. H., No. 1....316
Bailey, Peter, mine....423
Bailey, R. O., No. 1....304j, 389
Bakerstown coal....175
Bakerstown fire clay....177
Baldwin Steel Co....6
Ballard section....200
Banks of Charleston....8
Banner Window Glass Co....7
Bannister Heirs Nos. 1, 3-7, 10, 12-17....304f
Bannister Heirs Nos. 1 & 11....304g
Barlow, John....304g
Barlow section....75, 585
Barrier, Elizabeth....304e
Barth, Charles....304j
Barth, Nick, Nos. 1 and 2....304j, 331
Beane, W. S., No. 1....304h, 308
Beard, John, mine....435
Beaver Group of rocks....211
Beck, M. W....607
Belcher, Jas., No. 1....304j, 370
Belcher, J. W., mine....442
Bell, Emma, School section....117
Bell section....252
Belle section....285
Belmont coal....266
Belmont Coal Co....408
Belva oil strike....301
Berea Grit....303
Big Chimney section....187
Big Injun sand....302
Big Lime....302
Big Lime—Pittsburgh coal interval....300
Big Red cave....174
Big Sandy creek....48
Big Sandy district:
  Area of....2
  Available coal tonnage....567
  Minable coals....437-41, 452, 472
  Population of....2
  Prospective oil and gas....379
  Sections in....77-82, 146, 150-57, 194-7
  Well records....361-79
Bird, W. H....304h
Birmingham shale....168
Black Band coal....248, 274, 493
Black Band Coal & Coke Co., mines....274, 496, 498, 499, 511, 534-5, 552
Black Band Coal & Coke Co. well....304i
Black Band Iron Ore....238
Black Betsey C. Co. core tests, 419, 578
Black Flint, Kanawha....205, 255-66
Black Hawk C. Co. mine....500, 511
"Black Marble"....294
Black silicious rock....256
Blaine, Mrs., No. 1....304i, 380

Page
Blakeley section....197, 253
Blakeley mine....436
Blakes Branch section....291
Block seam....279, 513
Blue creek....48
Blue Creek P. O., Acct. of....13
Blue Creek C. & L. Co., Analyses of seams....462-3
Blue Creek C. & L. Co., Nos. 1-4 10, 13, 16, 20, 21....304h-k, 397
Blue Creek C. & L. Co. mines.... 405, 429, 431, 432, 433, 436, 442, 453, 459, 462, 473, 478-9
Blue Creek oil pool....362
Blue Creek oil sands....302
Blue Creek section....151, 153, 195
Blundon section....69, 150
Board, John, Nos. 116 & 117..304h, 369
Boerder, Anton....6
Boggess well....70
Boggess, F. E., No. 1.... ....304h, 305, 307, 309
Boggs, J. H., Nos. 1 & 2....304c
Bolivar fire clay....201
Bonami section....91, 131, 200
Booker Heirs Nos. 1 & 2....304b
Booker, W. L., Nos. 2-6....304b, 304c
Boone County sections....101-2, 245-50
Botkin, Chas., well....304j
Botkin, Riley....426
Bowen, S. C., No. 1....304i, 394
Bower No. 1....304j
Bowles, Wm., opening....113
Boyd, A. H., mines....460
Bradford, Mrs. mine....529, 533
Bradford, Mrs., No. 1....304i, 382
Brawley well....304h, 438
Bream section....77, 208
Brick plants....579-88
Brinegan, W. W., Nos. 1-4....304k
Brines....301
Brooks, A. B....602
Brooks et al....304i
Broun opening....421, 475
Brounland section....92
Brown, J. F., Nos. 1-16....304f, 304g
Brown, J. F., Nos. 455, 456, 465, 469, 476, 505 and 506....304k
Brown opening....420
Browns Creek section....170
Brownstown coal....286
Brownstown sandstone....285-6
Bruin Estate....417
Brush Creek coal....179
Brush Creek limestone....179
Bryan, A. J., mine....166
Bryan, D. J., No. 2....304i
Bryan, Jack, well....321
Buckner, S. A....304g
Buffalo sandstone....178
Buffalo-Mahoning-East Lynn sandstone....592
Bufford, J. S., mine....411, 417
Building stone....589-95
Burgess, J. M., coal bank....133
Burks Branch section....194-5
"Burning Springs"....296
Butler Estate, mines....559
Byrnside anticline....59

C

C. & A well....300
Page
Cabell, Chas....224
Cabell, H., Nos. 1 & 2....304g
Cabin creek....43
Cabin Creek Br., C. & O. R. R., Description....25
Cabin Creek Br., C. & O. R. R., Levels on....657
Cabin Creek Cons. C. Co., Analyses....555-6
Cabin Creek Cons. C. Co., Mines 225, 227, 229, 268, 284, 407, 466, 473, 503-5, 511, 524, 542-43, 546-50 553
Cabin Creek district:
Available coal tonnage....567
Core drill holes....569-73
Minable coals.... 444-52, 463, 472, 479, 489, 500-10, 519-24, 525, 528-31, 532, 538-51, 557-8, 564
Population of....2
Prospective oil and gas....293
Sections in.... 98-104, 198-9, 204, 208-9, 214-29, 236-44, 247-52, 282, 284-293, 444-51
Well records....387-94
Campbells creek....49
Campbells Creek coal....283
Campbells Creek C. Co., core test.... ....189, 304i, 577
Campbells Creek C. Co., mines.... ....405, 443, 552
Campbells Creek C. Co., sections.... ....189, 536, 537
Campbells Creek limestone....281
Campbells Creek mine....461
Campbells Creek R. R....27
Campiatt Coal Co., mines....518, 526
Campwell, John....304h
Cannelton Coal Co.... ....290, 405, 449, 539, 552
Cannelton limestone....288-9
Cannelton section....198
Canterberry, R. H....164
Carbon Black industry....605-6
Carbon Coal Co.... 224, 291, 406, 506, 524, 543-4, 553 558, 560
Carbon Coal Co., Analyses....553
Carbon section....226
Carboniferous rocks, Table of....66
Carboniferous rocks, Thickness of..107
Cardiff Coal Co....465
Carpenter, Elliott, No. 1....304j
Carnes, A. L....304k
Carnes, D. R., Nos. 1-9....304h, 304j
Carnes, M. L., mine....160
Carpenter, Thos. Nos. 1-3.... ....300, 304k, 353-4
Carroll, L. A., No.1....304e
Cart, E. T., No. 1....304c, 337
Cart, J. T., No. 1....304g
Carte, W. E., No. 1....304c
Casdorph, Sam'l, mine....162
Cassville Plant Shale....115
Cavender, Fanny....304e
Cavender, N. W., Nos. 1 & 2....304e
Cedar Grove, Acct. of....9
Cedar Grove coal.... ....278, 280, 516-27, 567
Cedar Grove coal, Analyses of....526
Cedar Grove Colliery Co., mine...449
Cedar Run Colliery Co....430, 453
Cespe-Kanawha Coal Co....427, 453

Page
Champ & Carter mine.....540
Charleston:
Account of.....4-8
Brick plants at.....580-8
Industries at.....5-8
Maximum and Minimum river stages 37-40
Population of.....5
Rainfall at.....37
Charleston district:
Area of.....2
Available coal tonnage.....568
Minable coals.....424-5, 452, 455, 472, 474-5 499, 510
Population of.....2
Prospective oil and gas.....387
Sections in.....95-98, 141. 186
Well records.....385-87
Charleston Fire Brick Co.....581
Charleston Interurban Co.....28
Charleston Mfg. Co.....7
Charleston & Pt. Pleasant Turnpike.29
Charleston & Ravenswood Turnpike.29
Charleston sandstone.....201, 592
Charleston sections..97, 98, 141, 184-7
Charleston Special quadrangle, Levels in.....664-5
Charleston Window Glass Co.....7
Charlmore mine.....514
Chesapeake Mining Co.....244, 408, 481, 489, 540, 552
Chesapeake & Ohio Railway, Account of.....24
Chesapeake & Ohio Railway, Levels on.....656
Chilton coal.....277-8, 513
Chilton sandstone.....277
Chilton section.....248, 277
City Water Works well.....304i, 386
Clarion coal.....208
Clarksburg coal, Little.....161, 418
Clarksburg limestone.....164
Clay Coal Co.....405
Claybrook Min. Co.....438, 453
Clay Products Co. No. 1.....304i
Clay, Robt., mine.....258-9
Clays 579-83
Clendenin quadrangle, Levels in...661
Clendenin section.....78, 81, 146, 152, 153, 195
Climate 609-10
Cline, Henry, No. 1.....304b
Coal:
Allegheny series.....419-54
Analyses, Miscellaneous.....163, 174, 421, 439, 450, 462, 485, 513, 556-7, 561
Analyses, Tables of.....416, 453, 473, 489, 515-16, 526, 533, 552, 555, 558, 561, 564, 565
Chapter on.....400-578
Conemaugh series.....418
Convention in 1855.....401
Intervals.....276, 300
Kanawha series.....454-569
Method of determining coal area 416
Minable coals by districts....409-578
Monongahela series.....409-18
Page references to mines.....418, 454, 474, 492, 512, 527, 534, 554, 566
Statistics of production.....400-9
Summary of Available coal....566-9
Table of intervals.....275, 276
"Coal and Iron," Article in.....402
Coal & Coke Ry., Account of.....660
Coal & Coke Ry., Levels on.....660
Coal & Coke Ry., Nos. 1, 2 and 5..363
Coal & Coke Ry., Right of Way Nos. 1, 4, 9-11.....304a. 304d, 304e
Coal & Coke Ry. Right of Way Nos. 1, 3, 5-8.....304f
Coal & Coke Ry.. sandstone quarry
Coal intervals, Table of.....275, 276
Coal river.....24, 41
Terraces along.....53
Coal River Br., C. & O. Ry., Account of.....25
Coal River Br., C. & O. Ry., Levels on.....658
Coal River Branch section....176, 177
Coal River Navigation Co.....42
Coal River O. & G. Co. No. 1.....86
Coalburg coal.....269, 474-92
Coalburg coal, Amount available.. .....489, 567
Coalburg Coal, Analyses.....490
Coalburg coal, Sections of.....271-2
Coalburg Colliery Co.....218, 406, 483, 489
Coalburg-Kanawha Coal Co.....408, 487, 489, 522, 526
Coalburg sandstone 269
Coalburg section 217
Coalburg syncline 62
Cobb, Mark A.....304h, 371, 438
Cobb well.....599
Coke production, Table of.....404
Coleman, E. M.....304j
Coleman, Jane, No. 1.....304d
Coleman, K. C., Nos. 1-8.....304d, 304e, 304g
Conemaugh series:
Chapter on.....127-82
Description of formations...159-182
General section.....127
Minable coals.....418
Sections of.....127-182
Thickness of.....107
Connell oil well.....328
Connellsville sandstone.....161
Conley Bros. mine.....411, 417
Conner, Jas., mine.....496, 511
Conner, Joseph 265
Contour lines.....57
Cook, Johnson mine.....457
Cooper creek.....47
Coopers Creek Coal Co...405, 426, 453
Copel, W. M., No. 1.....304g
Copeland well.....304h, 304k
Copen Branch section.....171
Copenhaver, Chloe, Nos. 1-17.....304d, 304f, 304g
Copenhaver, Floyd, section.....147
Copenhaver, Grant, No. 1...304j, 333
Copenhaver, J. H., Nos. 1-8, 10-12 .....304d, 304f, 345
Copenhaver, W. F., mine.....177
Copenhaver & Massie mine.....426
Core drill holes:
Black Betsey C. Co.....578
Campbells Creek Coal Co.....189
Courtney D. G., Nos. 1-4.....574-7
Dickinson, J. Q., Nos. 1 & 2..570-71
Gallego Land Co.....229

Page
Haggle creek.....245
LaFollette No. 1.....218, 572-73
Winifrede Coal Co.....99
Cork, Hon. J. F.....328
Courtney, C. D., Nos. 1-4.....304i
Courtney, D. G., core tests.191, 574-7
Courtney, D. G., No. 1.....395
Courtney, D. G., mines.....
.....457, 459, 495, 498, 511
Courtney, & Brown mine.....421, 456
Courtney Coal Co.....304i
Covington & Ohio Railroad.....24
Cox, Ohley & Humphreys.....304h
Crawford & Ashby mine and quarry.....178, 441
Crawford & Ashby wells.....
.....304h, 304i, 315, 322
Craze, T. B.....264
Crescent section.....241, 293
Creston Red Shale.....112
Crinoidal coal.....173
Cromwell, John.....304h
Crown Hill-Kanawha Coal Co.....408
Crown Hill opening.....522, 526

D

Daddow, Prof, Harris S.....402
Dams in Kanawha river.....85
Dana section.....82, 203, 259, 283
Dana. Terrace at.....53
Davidson & Gates Nos. 1-8..304c, 304d
Davis, Arthur, No. 1.....304d
Davis creek.....42
Davis Creek Mining Co.....497, 511
Davis creek section.....249
Davis, J. H.....304e
Dean, Ida.....304g
Decota Br., C. & O. R. R., Levels on.....657
Decota sandstone.....292-3
Decota section.....226, 293
Deel,, J. E., No. 1.....370
Dekalb silt loam.....618-19
Dekalb Stony silt loam.....619-21
Department of Mines, Tables of Coal Production.....403
Detroit section.....236, 291
Devonian rocks, Table of.....107
Diamond section.....251
Dickinson, Acct. of.....13
Dickinson, J. Q., mines and core tests.....444-5, 570-2
Dickinson, J. Q., wells.....
.....304i, 304j, 397, 596
Dillard, Geo., section and mine..
.....269, 434, 462
Dingess limestone, Fossils in....641-2
Districts, Area by.....1-2
Dodson, J. R., mine.....422
Donwood section.....102
Drainage Basins, descriptions of..33-54
Drilling Machinery, Invention of..297
Dry Branch Coal Co.....
406, 465, 473, 483, 489, 522, 526, 531
Dry Branch section.....214, 259
Dunbar, Acct. of.....12
Dunbar section.....143
Dunbar well.....304i, 314
Dungriff section.....248
Dunkard series:
Age of.....115
Chapter on.....108-115

Page
Description of.....111
Sections of.....108-111
Thickness of.....107
Durham, Jesse, Nos. 1-4.....304e
Ditch fork, Section on.....162
Dye, Robt., No. 1.....304j, 368

E

Eagle coal, Analyses of..561, 564, 565
Eagle coal, Description of.....
.....289-92, 560-6, 567
Eagle, Little, coal.....293-4, 566
Eagle limestone 294
Eagle limestone, Fossils in.....642
East Bank, Acct. of.....9
East Bank Mining Co....408, 522, 526
Eastern Carbon Co.....605
East Lynn sandstone.....204
Eden, Wesley.....304k
Edens, J. W., mine.....426
Edgell, J. E., Nos. 1 and 2.....304d
Edgewater section.....294
Edgewood section.....97, 170, 176
Edwards No. 1.....95
Edwards, Wm. H.....401
Edwards, Wm. S..(See Introduction)
Eldorado O. & G. Co. No. 2.....358
Electric Railroads.....28
Elevation of Kanawha county.....2
Elevations, Method of determining..58
Elk district:
Area of.....2
Available coal tonnage.....568
Early history.....327
Minable coal.....
415, 416, 452, 461, 472, 478-9, 489, 551
Population of.....2
Prospective oil and gas.....361
Sections in.....
74-77, 119, 147-50, 154-8, 187-98, 203, 207-8, 253, 271-74
Well records.....327-61
Elk fire clay.....179
Elk Lick coal.....166, 418
Elk Lick limestone.....167
Elk Ridge section.....242
Elk river.....24, 46
Sections at mouth of.....96
Terraces along.....53
Elk River Coal Co. No. 1...304f, 304k
Elk Twomile creek.....47
Ellison, Jas. H., mine.....423, 453
Eskdale section.....218, 220, 282
Estep Nos. 1 and 2.....304g
Eureka Coal Co. mine.....
...207, 449, 453, 502, 511, 539, 552
Evans, E. W., Report of.....329
Ewing limestone.....174

F

Fairview Church section.....164
Falling Rock Cannel C. Co. No. 1.375
Falling Rock Cannel C. Co., mine..441
Falling Rock creek.....48
Falling Rock section..150, 155, 157, 172
Faunal horizons.....640
Fayette county, Fossils collected in 642
Fayette county, Sections in.....
.....229-235, 241-3, 292-4
Ferry Branch section.....185
Fields creek.....43

Page
Fields creek section.....247
Fire clay.....583-4
Fisher Branch, Section on.....162
Flint, Kanawha Black.....205, 255-66
Floyd, G. J.....455
Floyd, John B.....425
Forests 601-5
Fossils in Kanawha Black Flint... .....257, 639-55
Fossils in Kanawha Series:
Allorisma cf. terminale.....642
Ambocoelia.....641, 642
Aviculipecten.....641, 642
cf. occidentalis.....642
Chonetes sp.....642, 643, 645, **650**
granulifer 650
verneuilanus 650
Conularia crustula.....644, **653**, 655
Crinoids 642
Derbya 641
crassa.....642, 643, 644, **649**
Discina capuliforma... 648
capuliformis.....648
Edmondia sp.....642
Enchostoma 644
elkens's....643, **645**, 654
Euomphalus sp.....642
Lingula mytiloides.....646
kanawhensis.....643, **647**, 654
umbonata...643, 644, **646**, 654
cf. umbonata.....642
Marginifera sp.....642
Myalina 642
Nucula 641
parva? 642
Nuculana sp.....642
Orbiculoidea capuliformis..... .....643, 648, 655
cf. capuliformis.....642
Orthis arachnoidea.....650
umbraculum? 649, 650
Orthisina crassa.....650
Pharkidonotus percarinatus.....642
Pleurotomaroid 642
Productus.....641, 642
cora.....642, 643, 644, 651
cf. cora.....**651**
symmetricus 651
cf. symmetricus.....643, **651**
Schizodus sp.....642
cf. affinis.....642
Spirifer.....641, 642
boonensis?..643, 644, **652**, 655
cf. boonensis.....641
Vermes incerti.....**645**
Foster, Allen, mine.....467-8, 473
Foster, Tom, mine.....468
Foster, William, mine.....523
Frankenberger No. 1.....304g
Franklin, I. W., well.....304i, 310
Frazier, Wm.....327
Freeport coal, Lower.....201
Freeport coal, Upper.....200
Freeport limestone. Upper.....201
Freeport sandstone, Upper.....201
Friendsville coal.....173

G

Gallego Land Co.....229
Gandy, A. A., mine.....437
Gardner, Fred, Nos. 1-3, 5, 6, 8-12, 17.....304a, 304b
Gas horizons of W. Va.....299
Gatchel wells (8).....304a, 304b, 304e
Gauge readings of Kanawha river.40-41
Gauley river.....51
Gay, Nathan, mine.....274
Geary district, Sections in.....82, 156
General section of Conemaugh series 126-7
General section of Kanawha Series 212-14 (See Introduction for revised section)
Geological formations, Table of.....66
Geology of salt horizon.....599
Geo-syncline 58
Gilboy sandstone.....121
Giles, Fayette & Kanawha Turnpike 29
Gillespie, Alexander, mine....412, 417
Gillespie, Henry, No. 1.....304e, 341
Goans, M. E.....304h
Goddard, W. H., leases.....327
Goff well.....304i
Good, J. W., No. 1.....304i, 318
Good, W. M.....304i, 312
Goshorn Nos. 1-8, 11, 13, 15-22.. .....304h, 304j, 304k, 356-7, 376
Goshorn Heirs Nos. 2-11..... .....304a, 304e, 304f
Gould and Parker Mine.....457
Gould and Parker Nos. 1-3..... .....300, 304i, 383
Grafton sandstone.....168
Graham Heirs Nos. 1-5.....304c
Graham, L. D., No. 2.....300
Grape Vine creek section.....167
Grave Yard well.....304g
Gray, J. M.....169
Greenbrier Limestone, Description of 302
Greenbrier Limestone, Thickness of 107
Grimsley, Prof. G. P..... .....30, 114, 115, 579, 590, 592, 595
Grose, No. 2 mine.....287
Grosscup, Hon. Fred P.....12
Guard, Jas.....508
Gunter, John.....328
Guthrie section.....167, 171
Guthrie syncline.....62
Guyandotte & Charleston Turnpike 29

H

Hackberry oil field.....355-61
Haggle creek core test.....245
Hale, Dr. John P.....5, 33, 595
Hall, F. J., mine.....476
Hall, B. B., No. 1.....304e, 336
Hall, S. R., No. 1.....304f, 339
Hall, Thomas, No. 1.....304e
Hammack, Lewis, No. 1.....304k, 334
Handley, Acct. of.....10
Handley section.....244
Handley syncline.....63
Hannah farm, Analysis of clay.....586
Hansford, Acct. of.....11
Hansford anticline 61
Hansford, B. H.....304i
Harding, B. J.....163
Harlem coal.....173, 418
Hayes, A. P., Nos. 1, 2, 4-14.... .....75, 304f, 304g, 363-4

Page
Hayes, C. Ed, Nos. 1, 3, 4, 5, 9.. ....304g, 304h, 372
Hayes, Davidson, Nos. 1-4..304e, 304g
Hayes, E. A.....304h
Hayes, J. E., Nos. 1-5.....304f, 349
Haynes, H. A.....412, 417
Haynes, John, mine.....413, 417
Haynes, Wythe, No. 1...72, 304i, 314
Haynes, W. M., mine.....166
Heavner No. 1.....300
Heizer section.....109
Hennen, Ray V.....487
Henson, J. M.....422
Hernshaw sections...93, 246, 249, 277
Hickory Camp section.....234, 292
Highcoal section.....101
Highways 28
Hill, L. C.....445
Hill, L. S.....208
Hill, R. C.....436
Historical and Industrial Development 1-29
History of Petroleum and Natural Gas 296-8
Holley Grove section.....240
Holly silty clay loam.....628-9
Holley & Stephenson C. & Co. Co 221, 406
Holmes Knob section.....142, 145
Holston sandy loam.....627
Holston silt loam.....625-27
Homewood sandstone.....254
Hoover, Thos. Nos. 1 and 2.....304f
Horton Mine Nos. 1 and 2....218, 272
House Branch section.....264
Howell, Bibbian, mine.....176
Hudling, Luther, opening.....431
Hudnell, Thos, mine.....433
Hughes, J. H., No. 1.....304b
Hughes creek 50
Hughes Creek Coal Co..... ...405, 480, 481, 489, 501, 538, 552
Hughes, Wm., No. 1.....304a
Hugheston Coal & Coke Co.....268
Huling, J. H., mine.....422, 453
Huling, J. H., wells..... .....301, 304i, 324, 381-2
Humphrey, A. B., mine.....414, 417
Humphrey & Cox well..... .....304h, 307, 309
Hundred sandstone.....111
Hunt section..... ....119, 120, 148, 154, 155, 157, 172
Huntington Estate mine.....538
Huntington loam.....631-2
Huntington fine sandy loam.....632-3
Huntington sandy loam.....633
Huntington silt loam.....630-31
Huffman, Chas., mine.....432
Huffman, Ed, Nos. 1-5.....304d

I

Icenhower, Sam'l, No. 1.....304e
Imperial Colliery Co....408, 562-3, 565
Indian Mounds, Description of...14-23
Ingles, Mrs. Mary.....595
Institute section.....129
Institute, terraces at.....52
Intervals, Pittsburgh coal & Big Lime 300
Intervals, table of coal.....275, 276
Iron ore.....601
Island Branch section.....120

J

Page
James, Jesse, Nos. 2-6.....304d, 304g
James River & Kanawha Turnpike..28
James, W. E.....558
Jarrett No. 1.....304i, 319
Jarrett, D. J., Nos. 1-14, 16..304a, 304b
Jarrett, Edward, No. 1...78, 300, 304b
Jarrett Heirs Nos. 1, 2, 4-6.304a, 304b
Jarrett, Jas., No. 1 .....304c
Jarrett, J. C., No. 1.....304c
Jarrett, John T., Nos. 1-3.....304e
Jarrett, O. M., Nos. 1-4.....304b
Jarrett, Stanford, Nos. 1 & 2.....304e
Jarrett syncline 62
Jarrett, Vernon, Nos. 1 & 2.304a, 304e
Jarrett, W. S., Nos 1-9.....304b
Jeffers, Thos. E.....35, 36, 37, 38
Jefferson district:
Area of.....2
Available coal tonnage.....568
Minable coals in.....410-13, 416
Population of.....2
Prospective oil & gas.....323
Sections in..... .....86-90, 128, 130, 132-9, 410-18
Well records.....318-24
Jenkins, J. C.....512, 555
Joblin, John.....304i
Johnson, Jefferson, mine.....435, 453
Johnson, Julian, mine.....529
Johnson, W. R., Coal Company....241
Jones, Alex., mine.....121
Jones, Andrew, well...304j, 304k, 332
Jones, Dr., No. 1.....67, 304b, 306
Jones Nos. 1 & 2.....300, 304e
Jones well.....300, 304k

K

Kanawha Beds, Upper.....212
Kanawha Black Flint.....205, 255-66
Analysis of.....265
Fossils in.....257, 640-41, 643-55
Kanawha Brick Company....179, 587-8
Kanawha Central R. R.....27
Kanawha & Coal River R. R.....27
Kanawha County:
Area by districts.....2
Location of.....1, 3
Population by districts.....2
Products of.....3
Property valuations in.....3-4
Towns and villages.....4-14
Kanawha district:
Sections in.....229-35, 241-2
Kanawha & Michigan Ry., acct. of..26
Kanawha & Michigan Ry., levels on.659
Kanawha Mine Car Co.....6
Kanawha & New River Brick Co...584
Kanawha river:
Description of.....28, 33
Drainage system.....30
Gauge readings.....40-41
Locks and dams.....33-35
Maximum and minimum stages..38-39
Navigation suspended.....36
Kanawha Series:
Classification of.....211
Fossils under cf. Fossils.....639
General section of (See Introduction for correct section).....212
Minable coals.....454, 569
Sections in.....212-295

Page
Kanawha Stone Co.....269
Kanawha Twomile creek.....46, 176
Kanawha Twomile creek section.. .....171, 181
Kanawha Water & Light Co....95, 300
Kanawha & W. Va. R. R., acct. of 26
Kanawha & W. Va. R. R., levels on 660
Kanawha & W. Va. Nos. 1-6..... .....304c, 304d, 304f
Kayford mine 284
Kayford section 224
Keefer, Burrell.....421
Keeferton section.....229, 292
Keener sand.....302
Keeney, W. J., mine.....446
Keeton, G. E., No. 2.....304c
Keeton Heirs, Nos. 1-5.....304c, 304d
Keeton J. N., Nos. 1 & 2.....304c
Kelly Axe Factory.....5
Kelly creek 49
Kelly Creek & Northwestern R. R...27
Kelly Creek Colliery Co..... .....271, 405 463, 480-81, 489, 521
Kelly Creek R. R.....27
Kelly, A. J. & B.....372
Kelly Heirs Nos. 1 & 2.....304j
Kelly, Jas., No. 1.....304j, 372
Kettle section.....118
Key rock.....56, 300
Kinder, Wm., well.....304k
King Sand Co., No. 3.....377
King Sand Co., mines.....440, 453
Kittanning coal.....184
Kittanning coal, Lower.....419-54
Kittanning coal, Middle....205. 419-54
Kittanning coal, Upper.....203, 419
Koontz, A. L., mine.....163
Koontz, L. V. & Bros., mine..437, 453
Krak, J. B.....409

L

Lackawanna Coal & Lumber Co... 249, 284, 287, 291, 470-71, 473, 484-7, 489, 493-4, 511, 540-1, 552-3, 560-62, 565
LaFollette core tests Nos. 1 & 2.. .....218, 572-3
LaFollette mines.....413, 503
LaFollette wells 304j
Laing, John.....403
Lamont Mining Co.....268
Lamont section 222
Latimer, W. J.....607
Laurel Fork section.....218, 264
Leewood Colliery Co.....282
Legg, R. C., No. 1.....304i
Legg section.....144, 145, 150
Lens creek 43
Lens creek section.....284
Lesley, J. P.....124, 200
Levels above tide in Kanawha..656-66
Levi, Plus, mine.....537
Lewis & Brown.....304k, 373
Lewis Coal & Coke Co..... .....406, 470, 473. 530, 533
Lewis, C. C., wells..106, 209, 304i, 304j
Lewis, J. B., mine.....527-8
Lewis, W. D., No. 1....300, 304i, 396
Lewis, W. D., mine....458, 477-8, 500
Lewis, W. S., wells.....62, 304h
Lewis section 86
Lewiston coal 266-9
Lewiston section 216, 266
Liberty section.....109
Lick Branch section.....202, 475
Lick Branch, well on.....358-361
Lincoln section.....130, 186
Little Clarksburg coal.....161, 418
Little Coal River Br., C. & O. Ry., levels on.....658
Little Eagle coal.....293
Littlepage, Adam.....304h
Littlepage & Gardner.....304h
Little Pittsburgh coal.....160
Little Pittsburgh limestone.....161
Little Sandy creek.....47
Little Washington coal.....113
Litton, Harry, mine.....442, 454
Lively, Samuel, mine.....200
Location of Kanawha area.....1
Locks and Dams on Kanawha river..33
Lock No. 2 section.....285
Lock No. 3 section.....280
Lock No. 4 section.....279
Lock No. 7 section.....143
Long Branch mine.....557
Lory No. 1.....300, 304j, 327, 330
Loudon district:
Area of.....2
Available coal tonnage.....568
Minable coals..... 422-4, 452. 456-8, 472, 475-6, 495-9, 510, 513-18, 525, 532, 534, 551, 556-7
Population of.....2
Prospective oil & gas.....385
Sections in..... 93-5, 183-5, 202, 206, 246-49, 274, 277-8
Well records.....379-85, 573
Low & Butler mines..... .....499, 509, 514, 517, 557
Lower Falls section.....137, 172
Lower Freeport coal.....201
Lower Marietta sandstone.....112
Lower Peerless sandsto.ne.....282
Lower Pittsburgh sandstone.....159
Lower Winifrede sandstone.....277
Lumber Industry.....603-4

M

Magazine Branch section.....186
Mahoning sandstone.....181
Main Hughes Creek section.....263
Malden, acct. of.....10
Malden district:
Available coal tonnage.....568
Area of.....2
Core drill holes.....574-7
Minable coals..... 442-4, 452, 458, 472, 476-8, 489, 500, 510, 518, 525, 527-8, 532, 536-7, 551
Population of.....2
Prospective oil & gas.....399
Sections in..... 82-86, 104, 189-93, 203, 251-2, 283
Well records.....394-9
Malden salt industry.....596
Malden sandstone 279
Malden section 84
Mammoth section.....193, 209, 262

Page
Mannington sandstone.....114
Marietta sandstone, Lower.....112
Marietta sandstone, Upper.....111
Marmet, acct. of.....16
Marmet Coal Co., core test No. 1..573
Marmet Coal Co., mines.....
10, 93, 277-8, 280, 284, 405, 419, 424, 513-14, 517, 519, 526, 535-6, 552
Marmet Coal Co. wells Nos. 0, 1-4 .....304i
Marmet section 95-290
Marmet, terraces at.....52
Martin, G. C.....173
Massy, Silas, mine.....469
Matheny, M. F., Nos. 1-4.....304e
Matheny, Squire, No. 1.....304f
Mauch Chunk, thickness.....107
Maximum and minimum river stages 37-40
Maxton sand.....301
McCabe, R. E., Nos. 1-3.....304c, 345
McClintic, Geo.....304g
McCutcheon, Jos., mine.....413
McDonald, John S., fire clay..584, 586
McDonald well.....304j
McMillan well.....304i
MacQueen, G. A., mine.....425, 453
Meadows, J. H., Nos. 1-5..... .....304g, 304h, 304j
Meadows, T. E., Nos. 1 & 2.....304j
Means, Wm., mine.....423
Mecca Colliery Co.....290
Meigs Clay Loam.....623-5
Melton, T. E., No. 1.....347
Meyers, Jackson, No. 1.....344
Miama syncline.....63
Middle Fork 45
Middle Fork section.....183
Middle Kittanning coal.....205
Milam, No. 1.....68, 300, 304h
Mill creek.....47
Mill Creek Cannel Coal Co.....304g
Milliken anticline 59
Milliken section 203
Milton, Thos.....304e
Mineral resources of Kanawha county 296-399
Mississippian rocks, thickness.....107
Mitchel, J., No. 1.....304c, 304f
Mitchell, Wm. No. 1.....304j
Moles, Jane O., Nos. 1, 2 & 4... .....304c, 304e, 343
Moles, M. P., Nos. 1 & 2.....304f
Monarch Carbon Co.....605
Monongahela series:
Chapter on.....116-126
Description of.....121-126
Minable coal.....409- 18
Sections 116-121
Thickness of.....107
Montgomery Coal Co., mines..... .....408, 502, 511
Montgomery quadrangle 662-3
Montgomery section.....240, 287
Moore, J. B., mine.....434
Moore School section.....135
Moore, S. S., Nos. 1 to 11..... .....304b, 304c, 304e, 338
Morgantown sandstone.....164, 590
Morlin, John, mine.....464
Morning Star School section.....116
Morris, B. S. & Fanny, Nos. 1-3..304f
Morris, Catherine.....461, 473
Page
Morris Creek Colleries Co.....408
Morris Fork Coal Co....405, 440, 453
Morris, M. E., Nos. 1 & 2.....304c
Morris, Walter.....304k, 342, 430
Morris, Wm.....304e
Morris, W. S.....304e
Moshannon Silt Loam.....634
Mottesherd, W. S.....304i
Mounds, Indian, acct. of.....14-23
Mount Carbon Coal Co.....232, 286
Mount Carbon No. 1 well.....300
Mucklow section.....238
Munice, Col. E.....37
Myers, Albert. Nos. 1-8....304b, 304c
Myers, C. C. & W. E., Nos. 1 & 2 .....304c
Myers, Edna, Nos. 1, 3 & 5.304b, 304c
Myers, E. C., Nos. 1 & 2.....304b
Myers, E. J., Nos. 1-4.....304b, 304e
Myers, G. B., No. 1.....304e
Myers, Geo., No. 1.....304b
Myers, G. E., Nos. 1-4.....304c
Myers, Hannah, No. 9.....304k
Myers, Jack, No. 1.....304c
Myers, John, mine.....456
Myers, U. C., Nos. 1-8.....304b, 304c

N

Nabob section.....224, 291
National Bituminous C. & C. Co.. .221, 268, 282, 464-5, 467, 473, 482, 484, 489
Natural Gas.....296-399, 524, 541, 553
Navigation on Kanawha, suspension of.....36
Naylon, No. 1.....304j
Nelson, Sidney, mine.....207, 428
New Cedar Grove Colliery Co., mine.....519 526
New Diamond Min. Co. mine..501, 511
Newberry, J. S.....173
Newhouse, J. S., Nos. 1-5..... .....304f, 304j, 347, 348
New River.....58
New River coals.....566
No. 2 Gas coal.....282-5, 534-56
No. 2 Gas coal, amount available..551
No. 2 Gas—Winifrede-Stockton in-.... ..tervals 276
No. 2 Gas coal, analyses of..552-3, 555
No. 5 Block coal.....205, 419-454
No. 5 Block coal, amount available 452, 567
No. 5 Block coal, analyses of.....453
Norris, Prof.....14
North Carbon section.....288
Nose of anticline.....55
Nucholls mine.....285

O

Odell section.....76
Ohio Fuel Oil Co.....303, 307
Ohley mine.....466
Ohley section.....219
Oil & Gas Development, early history 296
Oil & Gas sands, description of...301-3
Oil & Gas Horizons, table of.....299
O'Knight & Meyer, coal opening...206
Olcott Coal & Iron Co. mines..... .....406, 494, 511

Page
Olcott section....249
Orange section....250
Osborne, Geo., No. 1....304d
Osbornes Mills section....82, 156
Ord, W. D., report....508
Order of counties in production of coal....404
Oyler, Chas., mine....411, 417

P

Page Branch section....206
Page coal....283
Page, Maj. Wm....294
Paint creek....44
Paint Creek Branch, C. & O. Ry., acct. of....26
Paint Creek Branch, C. & O. Ry., levels on....657
Paint Creek Coal & Land Co., Nos. 1 & 2....238, 300, 304j, 390
Paint Creek Colleries Co....272, 407-8
Paleontology, chapter on....639-655
Peal, G. W. & M. A., mine....476
Peerless coal....281-2, 527-34, 567
Peerless coal, analyses of....533
Peerless Coal Co., mine...282, 528, 533
Peerless sandstone....281
Peerless, Lower, sandstone....282
Penmar Min. Co....427
Perdue, Paris, No. 1....304d
Perryville Coal Co. mine....459, 473, 477, 489
Persinger Coal Co....406, 523
Petroleum & Natural Gas....296-399
Peytona quadrangle, levels in....666
Phillips mine....430
Phillips, Nos. 1-4....304k
Physiography, chapter on....30-54
Piatt, Cam, well....304i
Piatt section....251
Pine Creek limestone....177
Pine Grove Coal Co....530, 533
Pittsburgh coal....124, 409-18
Pittsburgh coal—Big Lime interval.300
Pittsburgh coal, amount available....415-16, 567
Pittsburgh coal, analyses of....417
Pittsburgh coal, line of disappearance....125
Pittsburgh coal, structure of....125
Pittsburgh coal, Little....160
Pittsburgh limestone, Little....161
Pittsburgh red shale....174
Pittsburgh sandstone, Lower....159
Pittsburgh-Pomeroy sandstone....123
Pleasant Oak School House section....178
Plymouth C. & M. Co....419
Poca district:
Area of....2
Available coal tonnage....568
Minable coals....413-16
Population of....2
Prospective oil & gas....309
Sections in..66-71, 110-11, 117-20, 144-7
Well records....305-9
Pocatalico river....44
Pocatalico river, terraces along....54
Pocono Series, thickness....107
Point Pleasant Independent Republican....401
Polley, Rome, mine....200
Polly, Dan., No. 1....304i, 325
Pond Fork section....191
Population:
Cedar Grove....9
Charleston....4
Kanawha county....2
Other towns and villages....13
Saint Albans....9
Porter section....265
Porter Branch section....257, 267
Pottsville Series:
Chapter on....210-295
Classification of....211
Description of formations....254-295
Sections....212-295
Thickness of....107
Powellton coal....286, 556-9, 567
Powellton coal, analyses of....558-9
Powellton mine....286
Powellton, temperature at....610
Powellton No. 1....232
Pratt, acct. of....9
Pratt Land Co. No. 1....304j
Pratt section....243
Price, A. E., Nos. 1-3....304d, 304g
Price, B., No. 1....304d
Price, Ethel, Nos. 1-5..300, 304d, 304g
Price Heirs Nos. 1-3....304d
Price, John, mine....163
Price, M. J., No. 1....304g
Price, W. Armstrong, Notes on Paleontology by....639-55
Price, W. H., well....304i
Products of Kanawha county....3
Proctor, Preston, mine....435
Property valuations in Kanawha county....3
Prospective Oil & Gas Territory:
Cabin Creek district....393
Elk district....361
Jefferson district....323
Loudon district....385
Malden district....399
Poca district....309
Union district....318
Washington district....326
Putney section....84, 189, 191

Q

Quarrier, Russell, mine....518
Queen Land Co., Nos. 1-4....304h
Queen Shoals Coal Co....405, 439, 440, 453
Queen Shoals, Fossils collected at..640
Queen Shoals section....194
Quincy Coal Co. 405, 446, 488, 489, 501
Quincy syncline....63

R

Railroads, electric....28
Railroad, steam....24-28
Rainfall at Charleston....37
Ramsey, Charity E., No. 1....304a
Ramsey, G. W., mine....445
Raven Carbon Co....605-6
Ray, C. A., mine....415, 417
Ray, C. A., Nos. 1-3....304e, 304f
Ray. C. A. & D. E., No. 1....304f
Rays Branch section....184-5
Reamer No. 1....304j

Page
Rector, R. G.....434
Red Shale, Pittsburgh.....174
Red Warrior section.....245
Reese, P. S. mine.....414, 417
Report of E. W. Evans, geologist..329
Republic Coal Co. mine.....406, 506, 544-5, 553
Republic mine.....286, 450
Reynolds, G. G., Nos. 1-3.....304h, 304k, 374, 377
Reynolds, J. M., No. 1.....87, 304i
Rickering, J. F., No. 35.....304h
Rider, Nick, No. 1.....304j
Rigg, Wm., mine.....290
Right Fork section.....171
Ripley district, sections.....70
River and creek gravels.....589
Riverside coal opening.....522, 526
River stages, maximum & minimum.....37-40
River terraces.....52-54
Riverwash.....635-6
Road materials.....588-9
Robert Heirs, Nos. 1 & 2.....304j
Roberts, Jos., mine.....411, 417
Robertson, Sidney.....304h
Robinson, J. H., No. 1...88, 304i, 320
Robinson, Neill.....266
Robinson, Paris.....414, 417
Robinson syncline.....63-65
Rocky fork.....45
Rocky Fork section.....73, 140
Rogers, H. D.....116, 123
Rogers, Prof. W. B.....256, 400
Ronda section.....217
Rosen Coal Co.....477
Rosin Creek Co.....304i
Ross, J. R., Nos. 1 & 2.....304k
Rough stony land.....625
Rucker, Geo., No. 1.....304h, 368
Ruffner fire clay.....202
Ruffner Hotel well.....474
Rust, No. 1.....73
Rust, C. A., mine.....424
Rust, Chas. Heirs.....304i, 311
Ruth section.....138
Rutledge section.....193
Ryan, Joseph R.....304h, 369
Ryan, Patrick, quarry.....594
Ryan, W. E., well.....304h

S

Saint Albans, acct. of.....8
Saint Albans quadrangle, levels in.....665-6
Saint Albans sectian.....88, 89, 90, 128, 134
Saint Albans syncline.....62
Saint Albans, terrace at.....52
Salt Industry.....595-601
Salt sand.....301
Saltsburg sandstone.....175
Salt springs.....297-8
Salt water well, record of.....599
Sand City section.....221
Sand Run section.....179
Sands, Oil & Gas, description of.....298-303
Sandstone, outcropping.....589
Sandstone quarries.....589-95
Sattes, D. M. No. 1.....304i, 316
Sattes quarry.....590
Sattes section.....140, 165
Savage Bros. quarry.....255, 594
Scefler, John, No. 1.....304e
Schwartz & Barth Nos. 1-8 & 10.....303, 304c, 304d, 304e, 327, 336
School Lot Nos. 1 & 2.....304c
Scott, Frank, mine.....468
Scraggs & Smith mine.....556

Sections, Geologic:
Aarons.....148
Acme.....223
Aetna.....132
Alumville.....138, 173
Apgah.....78, 197
Barlow.....75
Bell.....252
Bell, Emma, School.....117
Big Chimney.....187
Blakeley.....197, 253
Blue Creek.....151, 158, 195
Blundon.....69
Bonami.....91, 131, 200
Bowles, Wm.....113
Bream.....77, 208
Brounland.....92
Browns Creek.....170
Burks Branch.....194-5
Cannelton.....198
Casdorph, Samuel.....162
Charleston.....97, 98, 141, 184-7
Chelyan.....215
Clendenin..78, 81, 146, 152, 153, 194
Conemaugh Series, Gen'l section.....127
Copen Branch.....171
Copenhaver, Floyd.....147
Crescent.....241, 293
Crown Hill.....215
Dana.....82, 203, 259
Decota.....226, 293
Detroit.....238, 291
Diamond.....251, 260
Dry Branch.....214, 259
Dungriff.....248
Edgewood.....97
Edgewood Drive.....170
Elk Ridge.....242
Elk River.....96
Eskdale.....218, 220, 282
Falling Rock Station.....150, 152, 157, 172
Ferrell Station.....139
Ferry Branch.....185
Gazil.....198
Goldtown.....70
Guthrie.....72, 144, 167, 171
Handley.....244
Heizer.....109
Hernshaw.....93, 246, 249
Hickory Camp.....234, 292
Highcoal.....101
Holly Grove.....240
Holmes Knob.....142
Hunt.....119, 120, 148, 157, 172
Institute.....129
Kanawha Brick Co.....180
Kanawha Series, Gen'l Section (See Introduction for revised section).....212
Kanawha Two Mile Creek...171, 181
Kayford.....224
Keeferton.....229, 292
Kettle.....118

Page

Sections, Geologist—Continued
King Station....179
Lamont....222
Laurel Fork....218, 264
Leewood....199
Legg....144, 145, 150
Lewis....86
Lewiston....216, 266
Liberty....109
Lick Branch....202
Lincoln....130, 136
Lock Seven....143
Lower Falls....137, 172
Magazine Branch....186
Malden....84
Mammoth....103, 109, 202
Marmet....95, 290
Middle Fork....183
Milliken Station....203
Montgomery....240
Moore School....135
Morning Star School....116
Mucklow....238
Nabob....224
New House Branch....186
Odell....76
Ohley....219
Olcott....249
Orange P. O....250
Osbornes Mills....82, 156
Page Branch....206
Piatt....251
Powellton....232
Pratt....243
Putney....84, 189, 191
Queen Shoals....194
Rays Branch....184
Red Warrior....245
Republic....204
Rocky Fork....73, 140
Ronda....217
Ruth....138
Saint Albans....88, 89, 90, 128, 134
Sand City....221
Sattes....140, 165
Shadrick Fork....204
Sharon....218
Shrewsbury....104
Sissonville....67, 68, 110 111, 118, 122, 147
Snow Hill....85
South Charleston....93
South Ruffner....202
Spangler....192, 196
Spring Hill....132, 178
Standard....236
Sugar Camp Branch....184
Tomsburg....237
Tornado....134, 136, 137
Trace Fork....246
Villa P. O....188, 193
Wacoma....238
Walgrove....75, 80
Wallace....73, 130
W. Va. Clay Products Co....180
Wevaco....228
Winifrede....99, 246, 247
Sewickley coal....123
Sewickley sandstone....123
Shadrick Fork. section....204
Shafer. A. J., mine....163
Shale pit on Elk river....168
Sharon section....218

Page

Sheltering Arms Hospital....11-12
Sheppard, James, wells....304i
Sherman district, sections in....101-2, 245-250
Shirkey, John G. Heirs, Nos. 1-6.304e
Shonk & Garrison No. 1....304j, 392
Shrewsbury section....104
Shrewsbury Hollow section....274
Sigman Fork, section on....160
Simmons Creek section....260
Sissonville, acct. of....13
Sissonville section....67, 68, 110, 111, 118, 122, 147
Skinner, J. V., mine....429
Skyler. Wm., No. 1....304i
Slack, Nos. 1 & 2....304a
Slack, Almira....304a
Slack, E. B., Nos. 1-3....304a, 346
Slack, Elizabeth, No. 1....304b, 304c
Slack, E. M., Nos. 1-3....304a, 304e
Slack, L. C., Nos. 1-4....304a, 304e
Slaughter creek....48
Slaughter Creek Coal Co. mines....469-70, 506-7, 523, 533
Slaughter Creek Land Co....451, 529
Smith, Enoch, well....304j
Smith, Green, Nos. 1-3....304b
Smithsonian Institution....14
Snodgrass, M., mine....290
Snow Hill section....85
Snyder & Barlow....304g
Snyder, M. R., No. 1....304h, 365
Soil Survey, chapter on....607-38
Soils, area of....617
Soils, summary of....636-8
Solvay Colliery Co....229, 292
South Charleston section....93
South Ruffner section....202
South Side Fdy. & Mch. Works....5
Southern Collieries Co....406, 467, 473, 541, 553
Southwestern Splint Fuel Co....408
Spangler section....192, 196
Spring Hill section....132, 178
Sproul et al. well....304i
Sproul mine....455
Squaw sand....302
Stafford, Jas., Nos. 2-4....304g, 304h
Standard Brick Co....6, 168, 582-3
Standard Kanawha Coal Min. Co..406, 431, 453
Standard section....236
Standard Splint & Gas Coal Co....237, 408, 486-7, 491
Staten Run section....289
Staunton, Dr. S. S., Nos. 1-7....304g, 350-53
Steam railroads....24-29
Steinbeck No. 1....304d
Stevenson, Dr. J. J....125, 161, 165, 168, 173, 175
Stewart, Chas....304g
Stewart, C. L., No. 1....304h, 334
Stockton cement bed....288
Stockton-Lewiston coal....266-9, 454-74
Stockton-Lewiston coal, amount available....472, 567
Stockton-Lewiston coal, table of....473
Stockton shales....266
Stratified rocks, thickness....107
Streams, table of....31-32
Stricklin, Albert....304e
Stricklin, Joseph, mine....433

Page
Stricklin, Wesley, Nos. 1-3 & 5.. .....304d, 304g
Strike of rocks.....55
Structure, chapter on.....65-65
Structure, method of representing 56-58
Sugar Camp Branch section.....184
Sullivan Machinery Co.....190
Summary of available coal.....566-9
Summary of well records.....304-5
Summers, C., Nos. 1 & 2...304g, 335
Summers, Christopher, Nos. 1-3..304a
Sunday Creek Co. mines..... 405, 446-8, 464, 479-80, 489, 500, 520-1, 526
Syncline, definition of.....55
Synclines, descriptions of:
Coalburg 62
Guthrie 63
Handley 63
Jarrett 62
Quincy 63
Miami 63
Robinson 63
Saint Albans.....62

T

Table of coal intervals.....275, 276
Table of well records.....304-5
Tate, Grant.....414
Tawney, John, mine.....439, 453
Taxation in Kanawha, rate of.....3-4
Taylor, D. E., No. 1.....304h, 378
Taylor, Wm., mine.....87, 410
Temperature at Powellton.....610
Terraces, river.....52-54
Thacker coal.....278, 513-16, 567
Thacker coal, analyses of.....515-16
Thacker, Jas., mine.....410
Thomas, Prof 14
Thomas, Walter.....412, 417
Thompson, Nos. 1 & 2.....304j. 388
Thumm Heirs, No. 6.....342
Thumm, J. F., Nos. 1-5 & 7-10... .....304a, 304b
Tompkins, No. 1, well.....304i, 398
Tomsburg section.....237
Tornado section.....134, 136, 137
Towns & Villages in Kanawha....4-14
Townsend, J. B.....304h
Trace Fork section.....246
Transportation, history of.....23-29
Trowbridge, Pike, No. 1.....90,324
Tupper creek.....45
Turner, John P.....400
Turner mine section.....207
Two Mile Creek section.....171
Two Mile Fork section.....171
Two Mile limestone.....169
Tyler Creek, section on.....164

U

Union district:
Area of.....2
Available coal tonnage.....569
Minable coals in.....410-13, 416
Population of.....2
Prospective Oil & Gas.....318
Sections in..... 71-74, 109-10, 116, 129-32, 140-45, 410-13
Well records.....310-18
Uniontown coal 122
Uniontown sandstone 122
U. S. Engineers, Stream Data from 35-41
U. S. Geological Survey, levels.. 661-6
Upper Carboniferous rocks..... 66
Upper Freeport coal.....200
Upper Freeport limestone.....200
Upper Freeport sandstone.....201
Upper Kanawha series.....212, 254
Upper Kittanning coal.....203, 419
Upper Pittsburgh-Pomeroy sandstone 123
Upper Winifrede sandstone.....272
Upshur clay.....621-2

V

Valley Grove Branch section.....259
Vancamp, M. & N. J.....304k, 340
Villa Coal Min. Co.....405, 428, 453
Villa section.....188, 193
Virginia Coal Co. 405, 458, 473, 537, 552
Vulcan Iron Works..... 6

W

Wacoma mine.....272
Wacoma section 238
Wake Forest Mining Co..406, 542, 553
Walgrove section 75, 80
Wallace, C. A., well.....304i
Wallace section.....72, 130
Ward section.....253
War Eagle coals.....295, 566
Warfield anticline.....59
Warfield coal.....283
Ward, Chas., Eng. Works.....6
Washington coal 112
Washington coal, Little.....113
Washington district:
Area of.....2
Available coal tonnage.....569
Minable soals..... ...420-21, 452, 455, 472, 475, 510
Population of.....2
Prospective Oil & Gas.....326
Sections in.....90-92, 131-8, 248-9
Well records.....324-6
Washington Fire Clay Shales.....113
Washington sandstone 113
Washington Springs 296
Water Ways.....23-24
Watson, R. F., No. 1...104, 300, 304j
Waynesburg coal 121
Waynesburg "A" coal.....114
Waynesburg sandstone 114
Webb Coal Co.....469
Wehrle, Dr. M., No. 1.....332
Weir sand 302
Weir wells, Nos. 12, 17-22, 25-6, 29, ...304h
Weir wells, Nos. 1-10.....304j
Weir wells, Nos. 11, 24, 28, 30-35, 37-40 .....304k
Well records, summarized table..304-5
Wertz, Chloe, Nos. 1-4.....304a
Wertz, Chloe et al.....304a
West Charleston well.....304i
West Va. Clay Products Co..... .....6, 180, 580-2

Page
West Va. Clay Products Co., well No. 1.....385
West Va. & Ohio Petroleum Co...328
West Va. Southern Ry.....27
West Va. Colliery Co. mines..... 284, 407, 505, 511, 531, 545, 546, 553
Wevaco section.....228
Whereley, Dr., wells.....304j, 304k
White, C. J.....175
White, David.....115, 266
White, G. W., Nos. 9 & 13.....304b
White, G. W., Nos. 1-8, 10 & 12..304c
White, Hester, mine.....173
White, I. C..... 114, 116, 121, 122, 123, 124, 125, 160, 161, 162, 164, 168, 169, 175, 177, 178, 210, 212, 255, 269, 272, 277, 281, 285, 286, 288, 289, 293, 294, 297, 298, 448, 592
White, John B.....304e
White, J. D., Nos. 1-3.....304k
White & Thomas.....304h
White well.....304i, 304k
Williams Coal Co.....405, 432, 453
Wills creek.....48
Wills Hollow mine.....436
Wills, S. H.....304j
Wilson, Mathew, mine.....499
Winifrede anticline 61
Winifrede coal, amount available.. .....510, 567
Winifrede coal, analyses of.....511
Winifrede coal.....223, 273, 492, 513
Winifrede Coal Co. mines..... 406, 451, 482, 488-90, 507-8, 511, 528-9, 533
Winifrede Coal Co. wells....304j, 391
Winifrede Coal Co., analyses of coals 513
Winifrede Limestone, fossils in...641
Winifrede Railroad 27
Winifrede sandstone, Upper.....272
Winifrede sandstone, Lower.....277
Winifrede section.99, 246, 247, 273, 274
Winifrede—Stockton—No. 2 Gas intervals 276
Wise, B. A., Nos. 1-6 & 8...304b, 304c
Wise, G. A., No. 8.....304b
Wiseman, J. G.....498
Witchers creek 49
Witchers Creek Coal Co.....530
Wolfpen Branch section.....166
Wood No. 1.....80
Wood, C. T., No. 5.....79
Wood, C. T., Nos. 3, 4, 6, 7 & 9 .....304d, 364, 366
Wood, C. T., Nos. 2, 4, 5 & 13..304e
Wood, C. T., Nos. 8 & 11.....304j
Wood, J. M. & H. L., No. 1.....304j
Wood, Louis, Nos. 1, 5 & 495-499 .....304g, 366
Wood, Wilson 304h
Wood, W. W., No. 1.....304i
Woodward Branch section.....166
Woody, Andrew, No. 1.....304e
Work, Dr. J. A., No. 1.....304d
Workman, J. B.....268
Worts and Slack.....304e
Wyant, Capt. Wm., mine.....289-90
Wyatt Coal Co..... 272, 406, 466, 473, 483-4, 490, 543, 553

Y

Yoder, M. E., No. 1.300, 303, 304i, 321
Young, C. S.....304h
Young, J. M. Nos. 1-6, 7-10, 12-14 .....304f, 362, 304d
Young, McClellan, No. 1.....304g
Young, Scott 304h
Young, Uriah, Nos. 1-3.....304d, 304j
Young, U. B., mine.....72, 412, 417

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